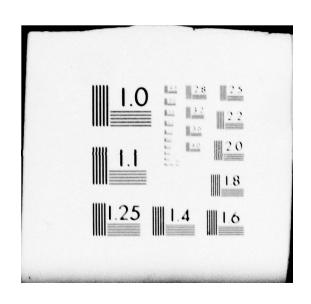
WOODWARD-CLYDE CONSULTANTS CHICAGO IL F/G 13/2 RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM. E--ETC(U) JUL 79 J PEREZ , Y LACROIX DACW43-78-C-0005 AD-A076 092 UNCLASSIFIED NL 1 OF 3 AD A076092 TOTAL





VOLUME II A APPENDICES A THROUGH G

### RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM

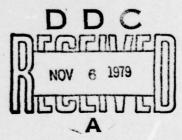
EXISTING LOCKS AND DAM NO. 26
MISSISSIPPI RIVER, ALTON, ILLINOIS

Prepared for



United States Army Corps of Engineers ...§crops the Army

St. Louis District



By

Woodward-Clyde Consultants
Chicago, Illinois

15 July 1979 Contract No. DACW43-78-C-0005 Y7C825

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# PHASE IV REPORT

APPENDICES A THROUGH G

RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM.

EXISTING LOCKS AND DAM No. 26 MISSISSIPPI RIVER, ALTON, ILLINOIS

Volume IIA. Appendices A through G. Phase IV Report.

Prepared for



St. Louis District

Bv

Jean-Yves Perez

Yves / Lacroix

Wes Lacroix

Woodward-Clyde Consultants
Chicago, Illinois

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
T. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER	
FOUNDATION INVESTIGATION AND TEST PROGRAM, LOCKS AND DAM 26, MISSISSIPPI RIVER, ALTON, ILLINOIS  Volume II A		5. TYPE OF REPORT & PERIOD COVERED Final report	
		6. PERFORMING ORG. REPORT NUMBER	
7. AUTHORA		S. CONTRACT OR GRANT NUMBER(s)	
Jean-Yves Perez Yves Lacroix		DACW43-78-C-0005	
D. PERFORMING ORGANIZATION NAME AND ADDRI Woodward-Clyde Consultants 11 East Adams Street Chicago, IL 60603		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE	
U. S. Army Engineer District, St. Louis 210 North 12th Street		June 1979	
St. Louis, MO 63101		191	
14. MONITORING AGENCY NAME & ADDRESS(If different from Controlling Office			
		15a. DECLASSIFICATION/DOWNGRADING	

#### 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, If different from Report)

Overview of Foundation Investigation and Test Program
Results and Interpretation of Chemical Grouting Test Program
Appendices A through G. Results and Interpretation of
Chemical Grouting Test Program
Results and Interpretation of Pile Driving Effects Test Program
Appendices H through T. Results and Interpretation of
Pile Driving Effects Test Program
Results and Interpretation of Drilled-In Pile Test Program
Appendices A through E. Results and Interpretation of
Drilled-In Pile Test Program
Results and Interpretation of Rock Anchor Test Program
Appendices A through E. Results and Interpretation of Overview of Foundation Investigation and Test Program

Vol IVA

Appendices A through E, Results and Interpretation of Rock Anchor Test Program

19. KEY WORDS (Continue on reverse side if necessary and identify by block masher)

Lock and Dam No. 26, Mississippi River Timber piles Chemical grout test Alluvial sands

Rock anchor test Benoto method

Drilled-in pile test Instrumentation of tests

Pile driving effects test Vibrational effects on structures

. ABSTRACT (Continue on reverse side if necessary and identify by block number) A series of tests examining various foundation systems and construction techniques were conducted on Ellis Island near Locks and Dam No. 26 in alluvial sand deposits underlain by glacial deposits and limestone. The chemical grout test consisted of grouting the upper 20 feet of the alluvial sand by injecting a number of different silicate and cement-bentonite grout types, while varying the grouting method, hole spacing, and injecting rates. Heave, lateral displacement, and pore pressure were monitored during grout injection. The in situ properties of the sand were measured before and after grouting by standard

18. SUPPLEMENTARY NOTES

Co NT '

20> penetration tests, static cone penetration tests, pressuremeter tests, bore hole permeability tests, and shear wave velocity tests. Concurrently laboratory tests were conducted to investigate the strength and creep behavior of the grouted sand. After completion of grouting, the site was excavated to examine and evaluate the grouted sand. In the rock anchor test, inclined rock anchors were installed in limestone through 130 feet of alluvial and glacial deposits using a pneumatic down-the-hole hammer with an offset reamer. Load tests were conducted on three instrumentated rock anchors and the feasibility of installation of the rock anchors was determined by evaluating loss of ground during installation, performance of the installation equipment, and rate of installation. The drilled-in pile test consisted of installation of large diameter high capacity pipe piles by the Benoto method. The feasibility of installing these piles was determined by evaluating loss of ground during installation, performance of the Benoto equipment, and rate of installation. In the pile driving effects test, pile founded monoliths were constructed, supported on either one, eight or twelve timber piles jetted and driven in alluvial sand to a depth of 35 feet. After applying lateral and vertical load to the monoliths, steel piles were driven at varying distances from the monoliths while monitoring movement of the monolith and supporting piles; shear, moment, and axial load in the timber piles; and pore pressure, movement, and particle velocity, in the soil. Parameters examined were pile type being driven (sheet, pipe, or H-pile), pile driving hammer (diesel, air-steam, or vibratory), distance of driven piles from monolith, driving of multiple piles at the same distance from the monolith, load level applied to the monolith, and soil properties (grouted and ungrouted). Vertical and lateral load tests were conducted on each pile founded monolith. Tests were also conducted to assess what effect grouted soil has on piles. Piles were driven in both grouted and ungrouted sand to examine driving characteristics and lateral load tests were conducted on H and pipe piles in both grouted and ungrouted sand.

# PHASE IV REPORT VOLUME IIA

### RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM

APPENDIX A
TEST AREA SUBSURFACE CONDITIONS

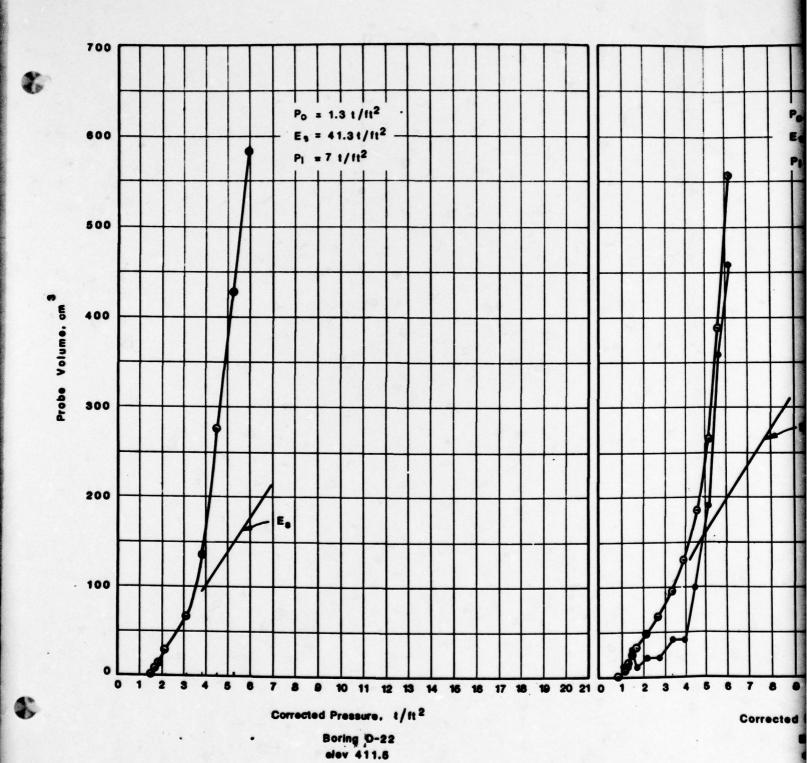
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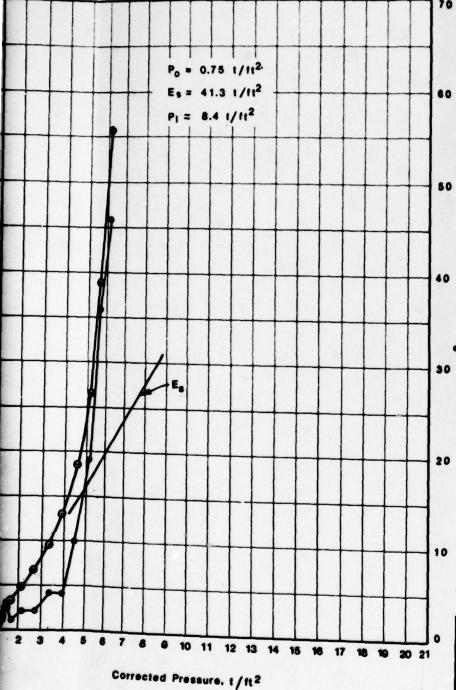
# APPENDIX A TEST AREA SUBSURFACE CONDITION

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Figure A.9 GRAIN-SIZE DISTRIBUTION OF ALLUVIAL SAND BEFORE GROUTING
Figure A.10





Boring D-27

#### Legend

- O Probe Volume Change versus Corrected Pressure
- Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- Pl Limit Pressure

CHEMICAL GROUTING TEST PROGRAM

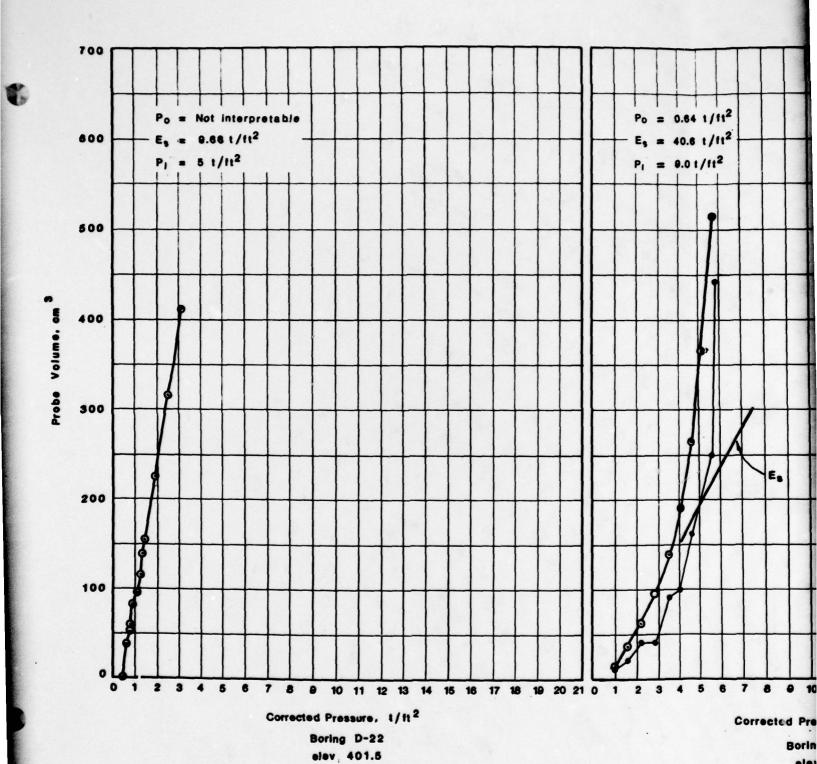
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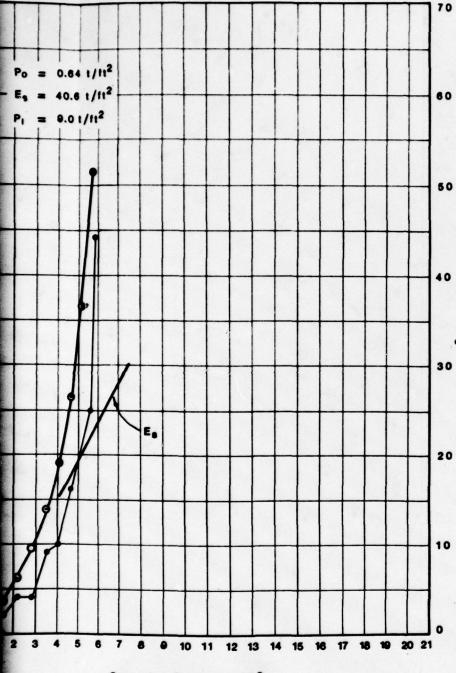
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EXISTING LOCKS AND DAM No. 26
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DACW43-78-C-0005

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Fig. A. 1

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Corrected Pressure, 1/112

Boring D-27 elev 402

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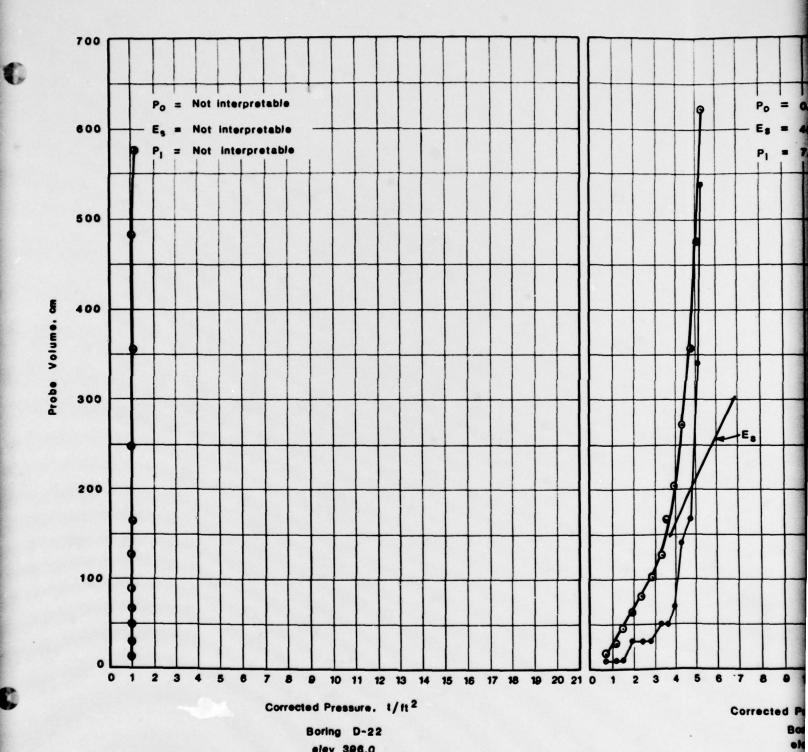
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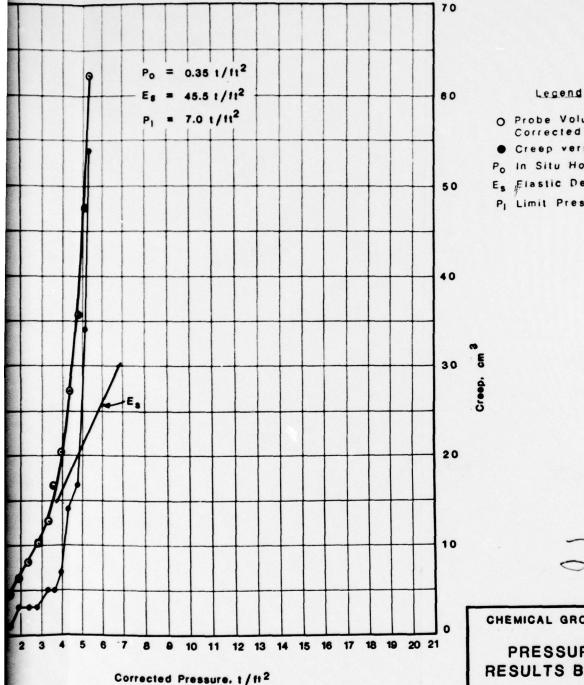
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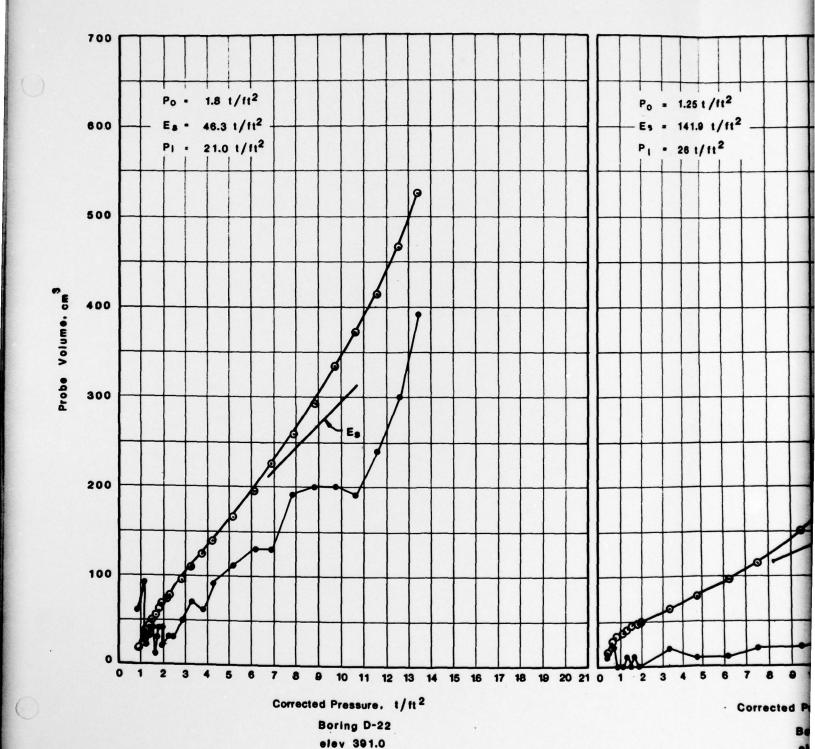
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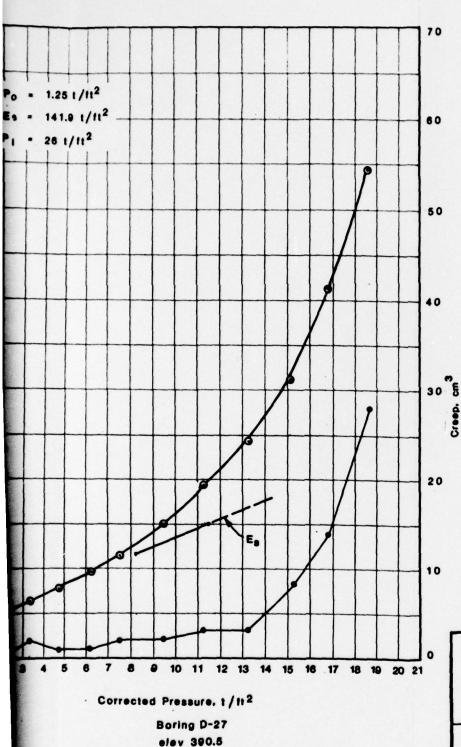
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PRESSUREMETER TEST RESULTS BEFORE GROUTING.

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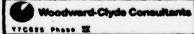
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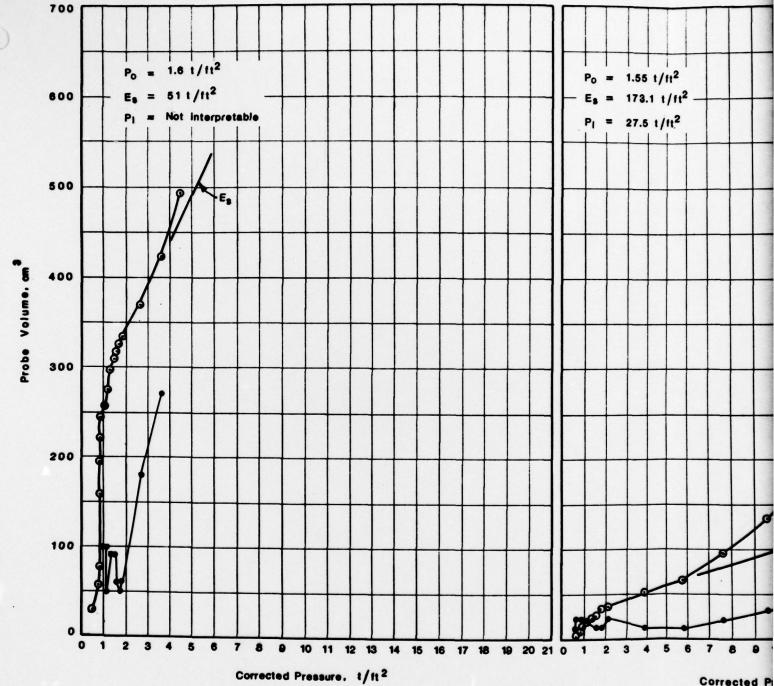
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CHEMICAL GROUTING TEST PROGRAM

PRESSUREMETER TEST
RESULTS BEFORE GROUTING

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 28
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DACW43-78-C-0008

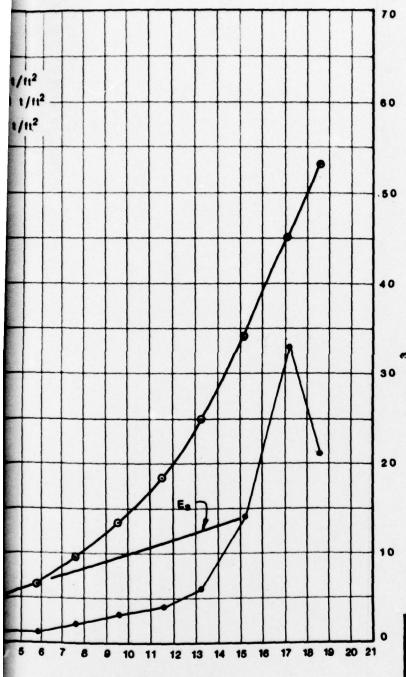




Boring D-22 elev 386.0

Corrected P

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Corrected Pressure, 1/112

Boring D-27 elev 387.5

#### Legend

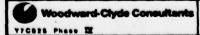
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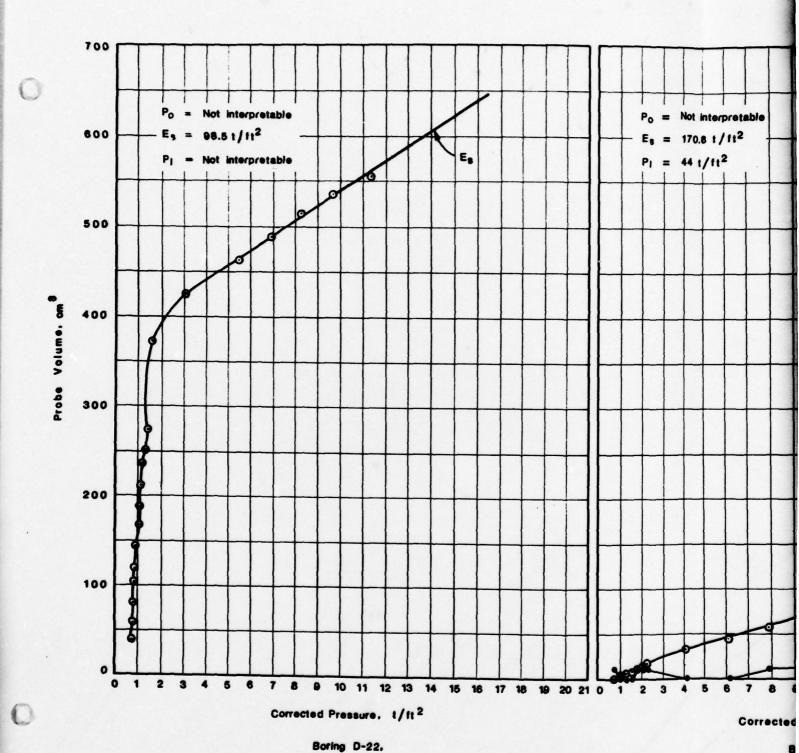


CHEMICAL GROUTING TEST PROGRAM

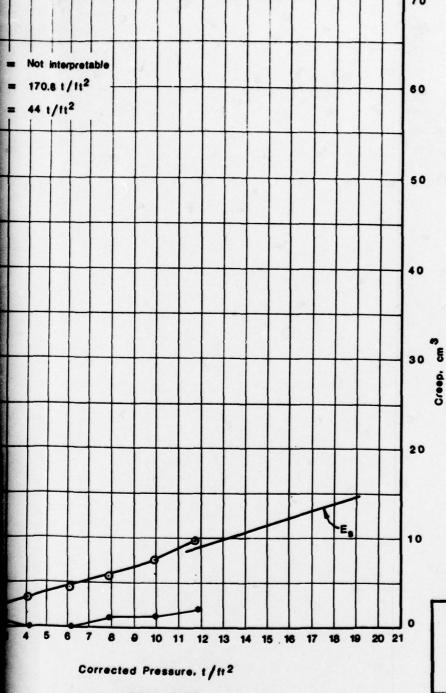
PRESSUREMETER TEST
RESULTS BEFORE GROUTING

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EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.
DACW45-76-C-0065





elev 381.5



Boring D-27.

#### Legend

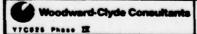
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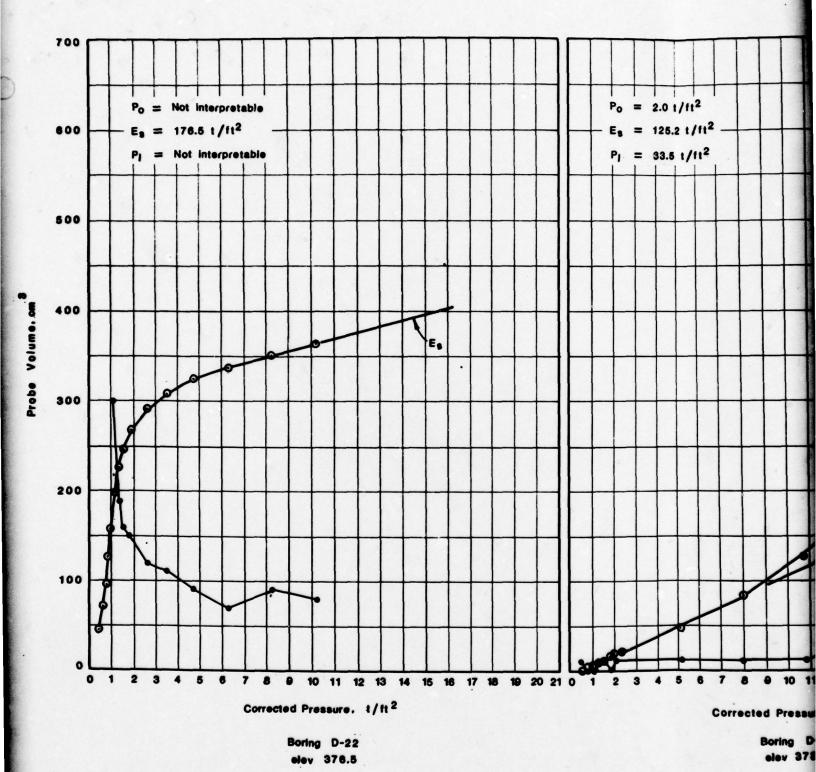
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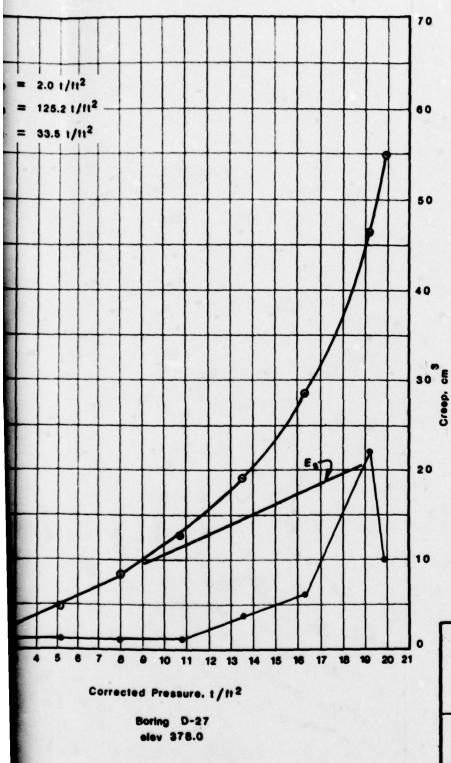
CHEMICAL GROUTING TEST PROGRAM

PRESSUREMETER TEST
RESULTS BEFORE GROUTING

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0005







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- · Creep versus Corrected Pressure
- Po in Situ Horizontal Stress
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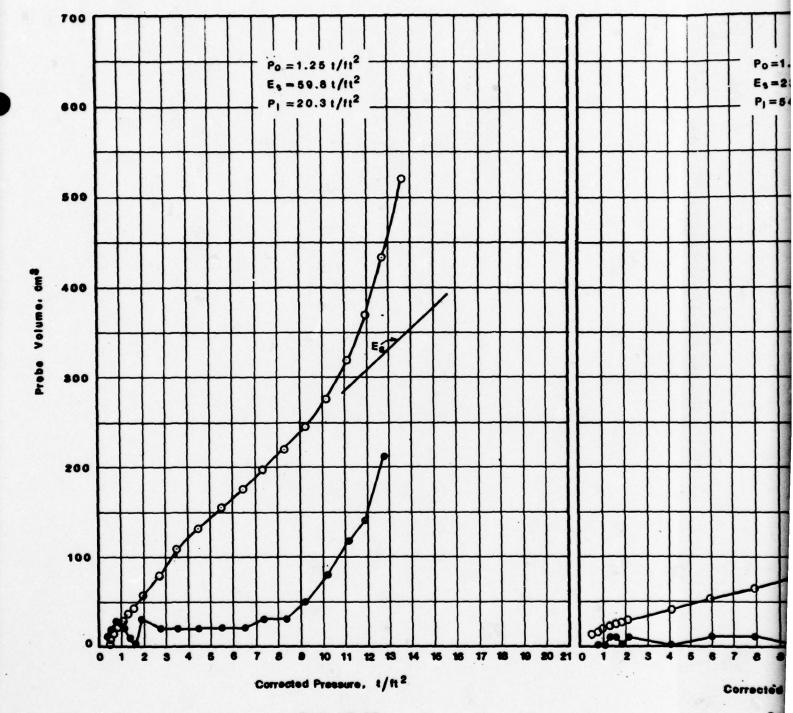
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PRESSUREMETER TEST
RESULTS BEFORE GROUTING

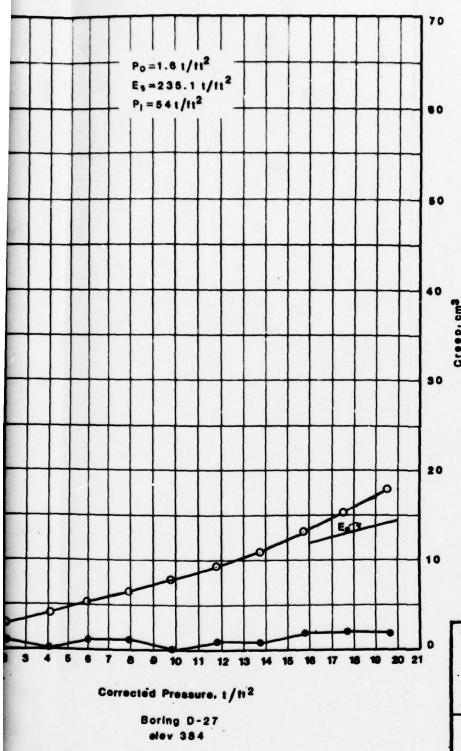
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Boring D-27 elev 393.5



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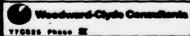
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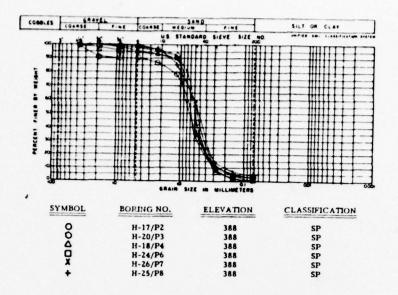
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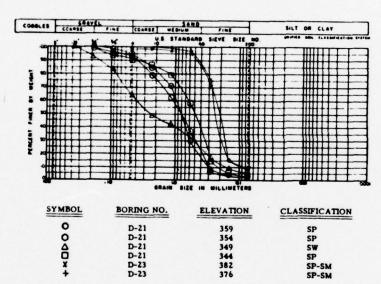
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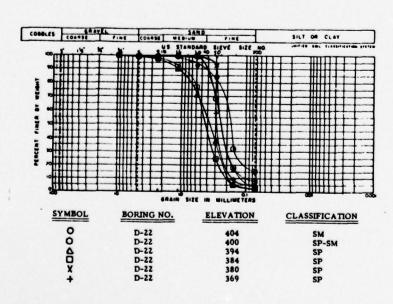
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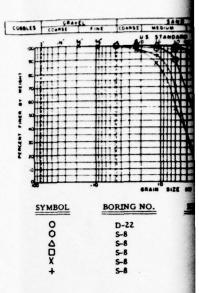
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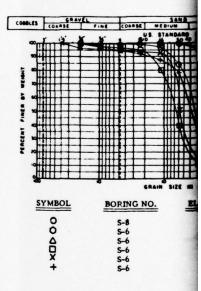


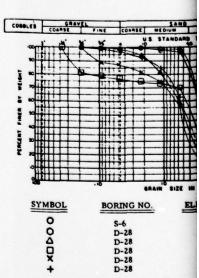


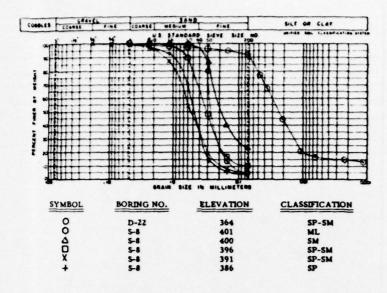


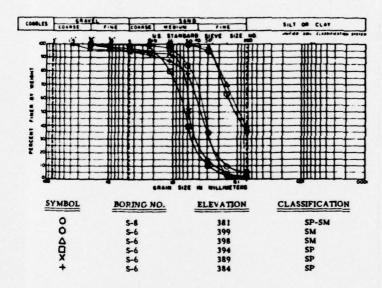


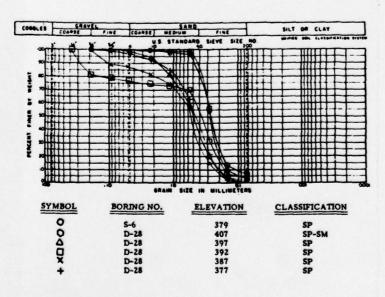










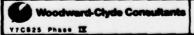


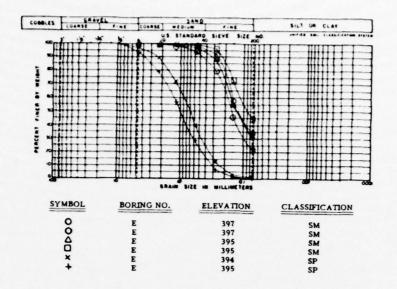


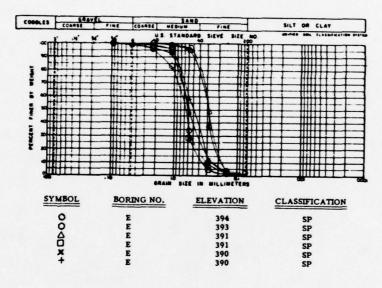
#### CHEMICAL GROUTING TEST PROGRAM

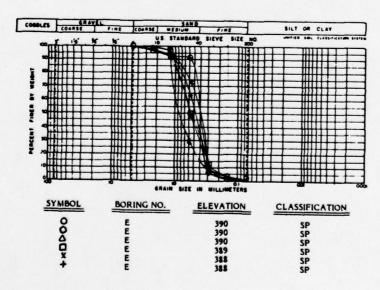
#### GRAIN-SIZE DISTRIBUTION OF ALLUVIAL SAND BEFORE GROUTING

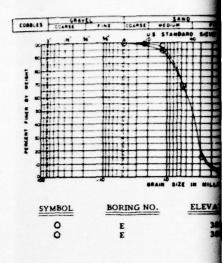
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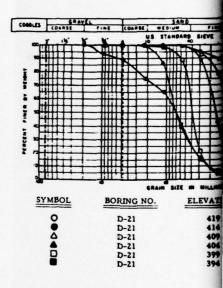


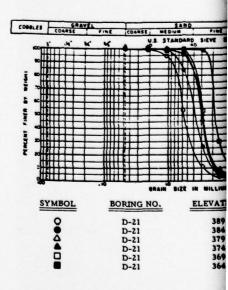


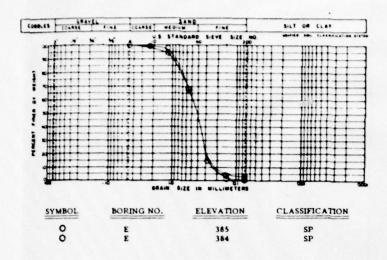


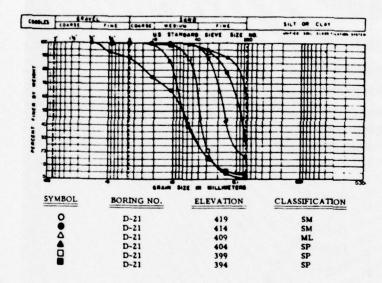


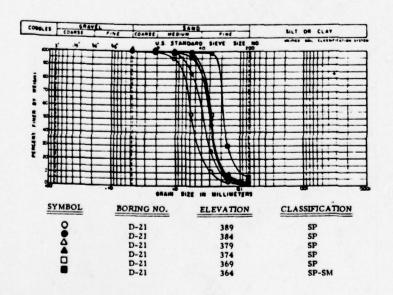














#### CHEMICAL GROUTING TEST PROGRAM

# GRAIN-SIZE DISTRIBUTION OF ALLUVIAL SAND BEFORE GROUTING

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
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# PHASE IV REPORT VOLUME IIA

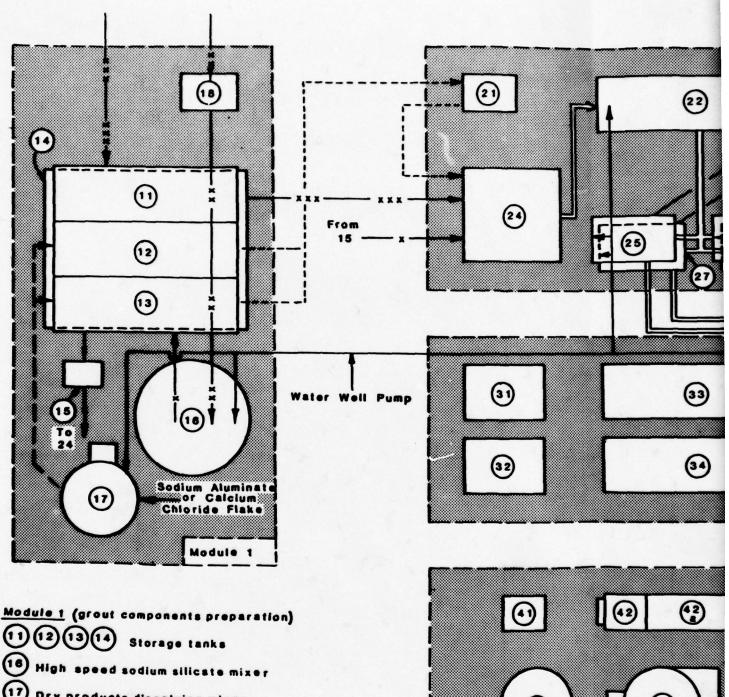
RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM

APPENDIX B
GROUTING PLANT

# APPENDIX B GROUTING PLANT

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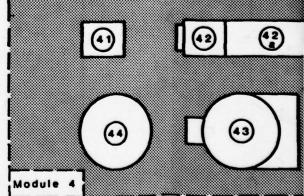
Figure B.1 through Figure B.3 GROUTING PLANT OPERATION

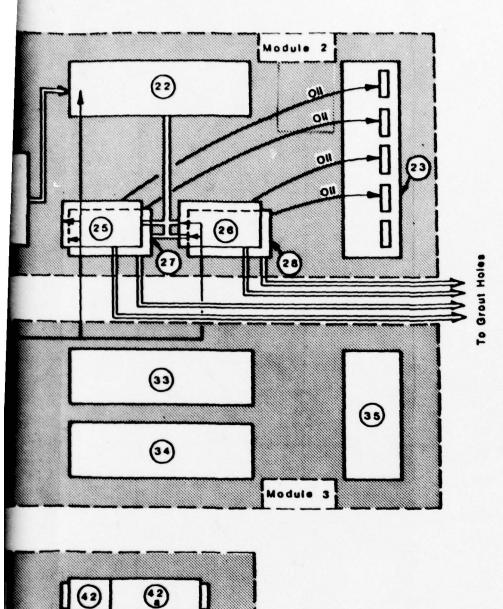


- Dry products dissolving mixer
- Sodium silicate supply pump

### Module 4 (auxilliary pumping unit)

- Pump from Module 4 to Module 3
- Proportioning tanks
- Buffer grout tank





Module ? (main pumping unit)

- 21 Pump
- (22) Main grouting pump
- (23) Control panel
- 24 Proportioning and mixing
- mother tank
  Through 28 metering and
  grouting pumps

Module 3 (cement-bentonite
or auxilliary unit)

- 31 32 Metering tanks
- 33 34 Main grouting pumps
- (35) Electrical panel

LEGEND

- Water

-xx- Concentrated Sodium Silicate

Micate Sodium

-xxx- Formamide

Sodium Aluminate or Calcium Chioride Solution

Grout

011



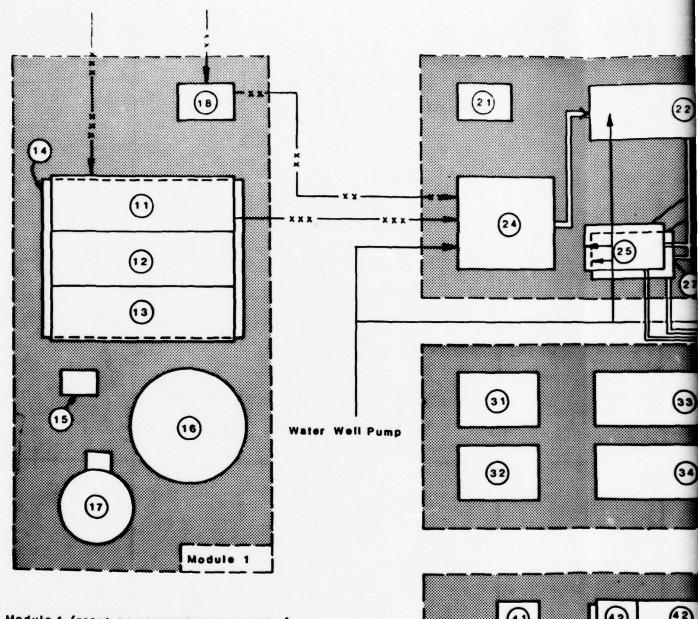
CHEMICAL GROUTING TEST PROGRAM

GROUTING PLANT OPERATION
FOR SIROC GROUTS

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS,
DACW43-76-C-6666

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Fig B.1

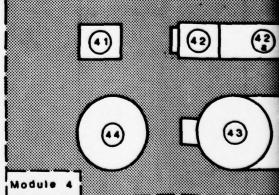


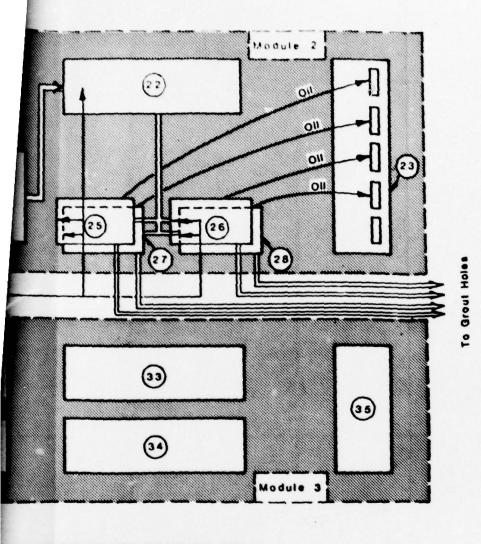
### Module 1 (grout components preparation)

- 11 12 13 14 Storage tanks
- 16 High speed sodium silicate mixer
- 17 Dry products dissolving mixer
- 18 Sodium silicate supply pump

### Module 4 (auxilliary pumping unit)

- Pump from Module 4 to Module 3
- 42 42 Proportioning tanks
- 43 Mixer
- (44) Buffer grout tank







- 21) Pump
- (22) Main grouting pump
- 23 Control panel
- 24 Proportioning and mixing
- mother tank
  Through 28 metering and
  grouting pumps

## Module 3 (cement-bentonite or auxilliary unit)

- 31 32 Metering tanks
- (33) (34) Main grouting pumps
- (35) Electrical panel

#### LEGEND

--- Water

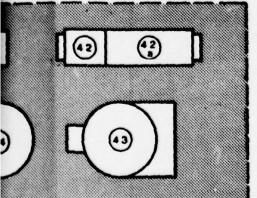
x- Concentrated

Sodium Silicate

-- RE00

= Grout

OH





CHEMICAL GROUTING TEST PROGRAM

GROUTING PLANT OPERATIONS FOR SILICATE R 600 GROUTS

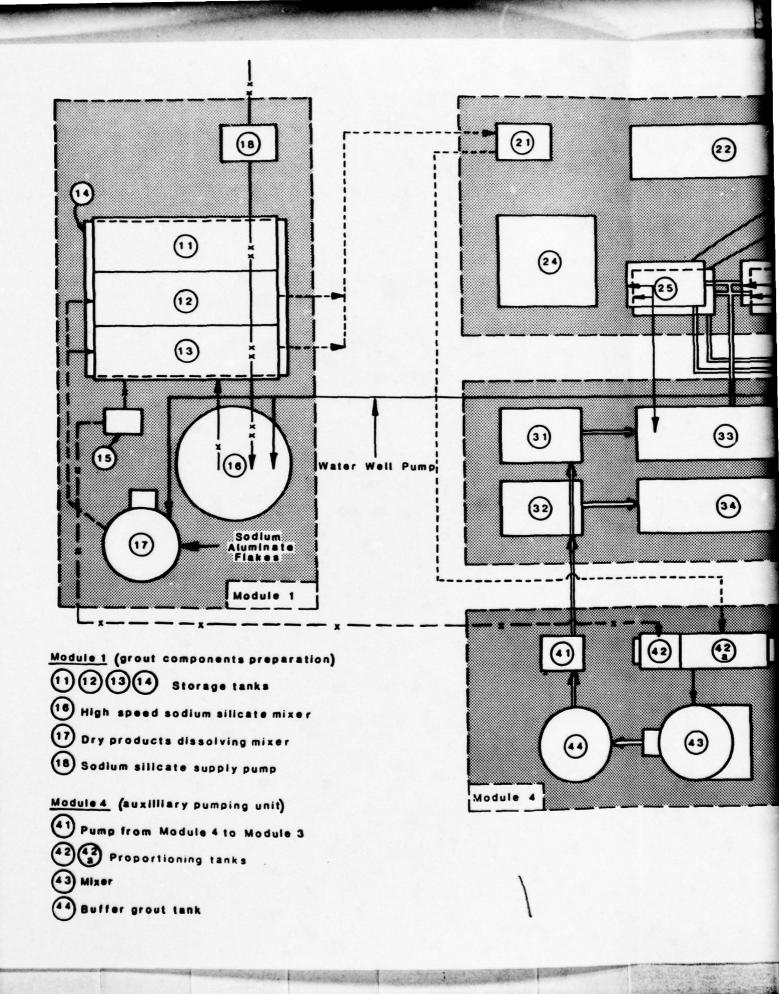
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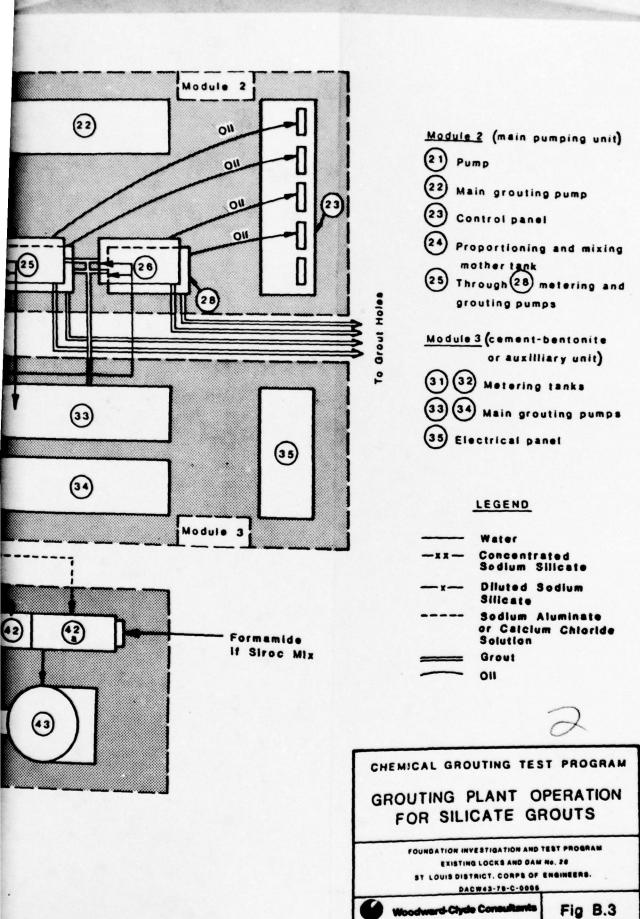
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Fig B.2





YTC825 Phase I

# PHASE IV REPORT VOLUME IIA

RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM

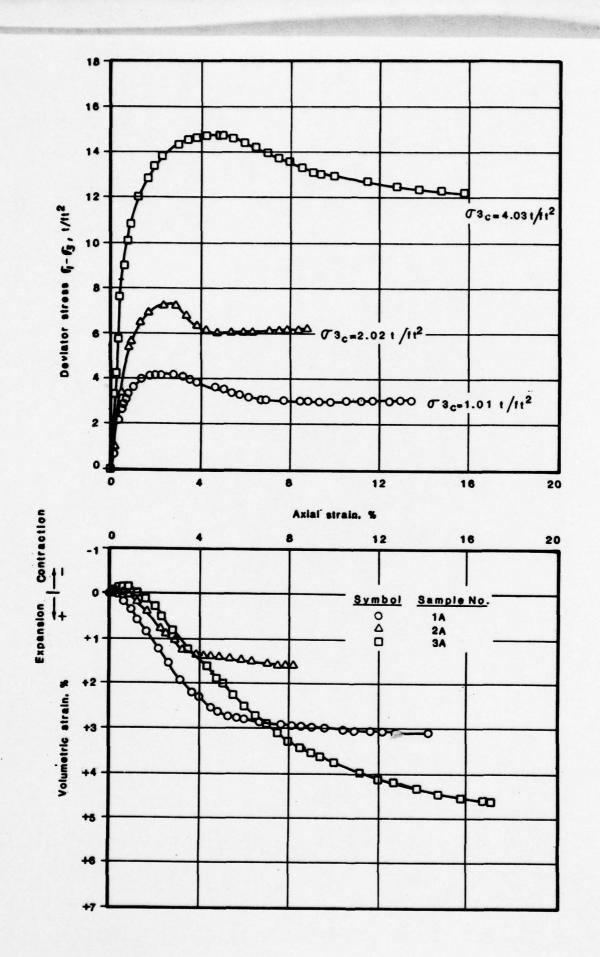
APPENDIX C GROUTS

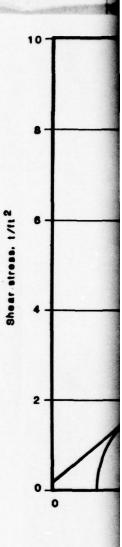
## APPENDIX C GROUTS

C

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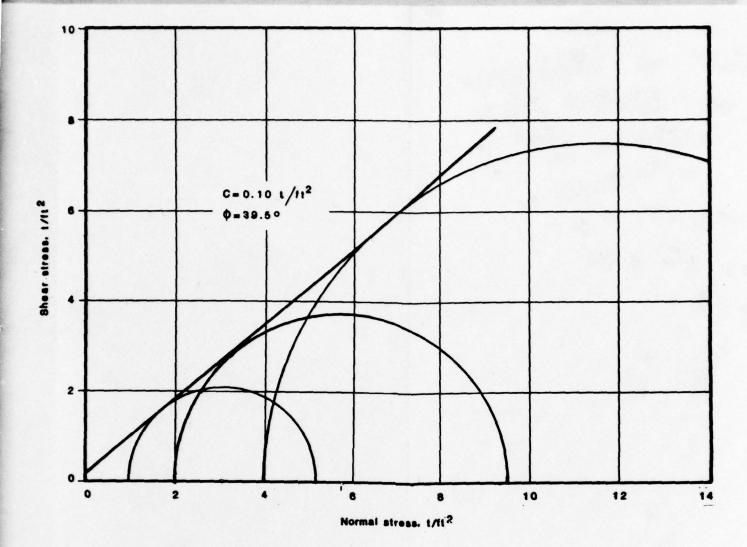
Figure C.1	RESULTS OF CID TRIAXIAL COMPRESSION TESTS, UNGROUTED RECONSTITUTED SAND SAMPLES
Figure C.2	RESULTS OF UNCONFINED COMPRESSION TESTS, RECONSTITUTED SAND SAMPLES GROUTED IN THE LABORATORY
Figure C.3 through Figure C.8	RESULTS OF CID TRIAXIAL COMPRESSION TESTS, RECONSTITUTED SAND SAMPLES GROUTED IN THE LABORATORY





### Notes:

- 1 Axial
- 2 Sand a D, -70
- 3 Sand and 6.



#### Notes'

- 1 Axial strain rate 0.5 %/min
- 2 Sand samples were reconstituted at D<sub>r</sub>=70% (8d 108=1b/ft<sup>2</sup>)
- 3. Sand samples were 2.8- in.-dia and 6.6- in.-high



CHEMICAL GROUTING TEST PROGRAM

RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
UNGROUTED RECONSTITUTED
SAND SAMPLES

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0008

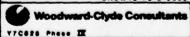
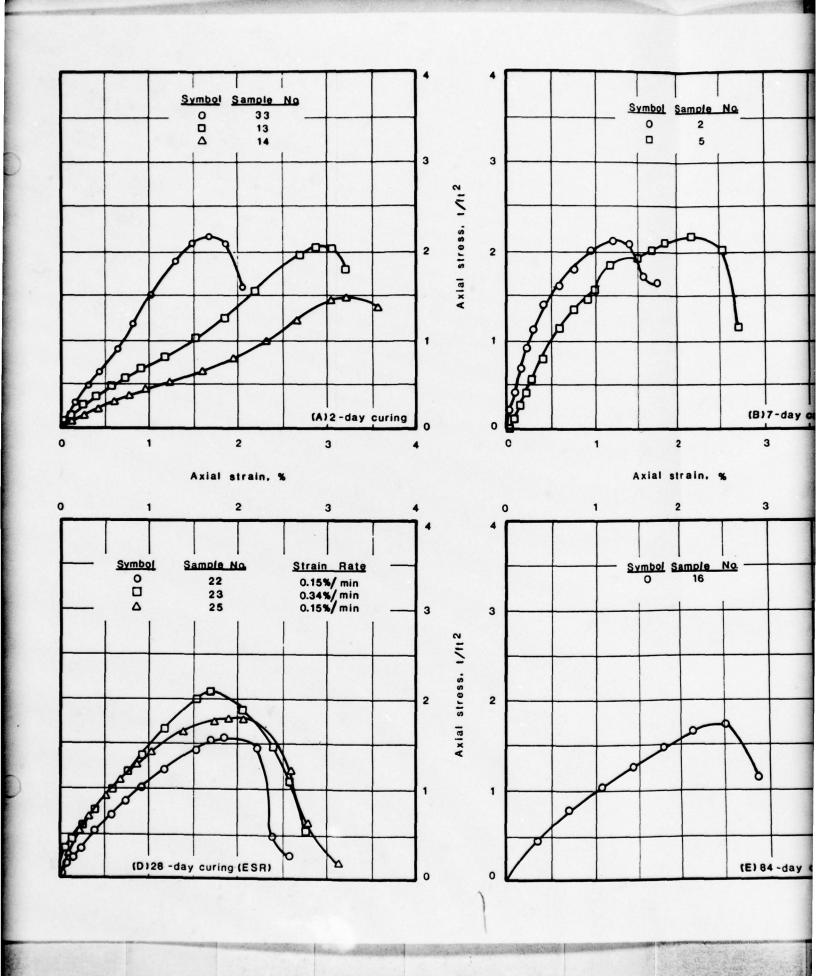
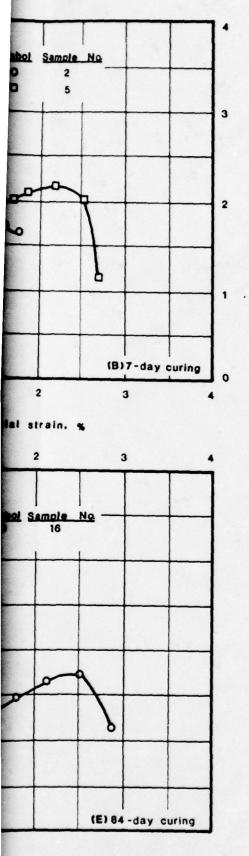
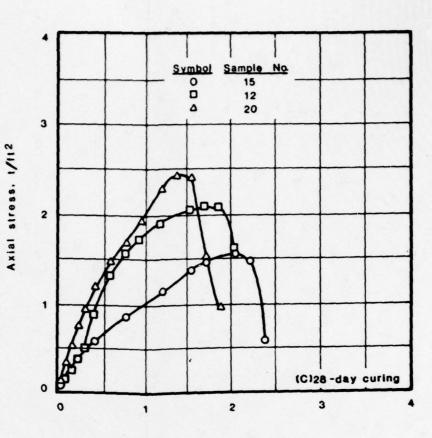


Fig C.1







#### Axial strain. %

#### Notes

- 1. Axial strain rate = 0.5 %/min except (D)
- 2 Sand samples were reconstituted at Dr=70 % (%d 107.9 lb/ft<sup>3</sup>)
- 3. Sand samples were 2.8 -in.-dia and 6.6 -in. -high
- 4. Grout was 35% Siroc 142 with the following composition (by volume)

Sodium Silicate 35%
Formamide 6%
Sodium Aluminate 0.15 lb/gal
Water 58%

CHEMICAL GROUTING TEST PROGRAM

RESULTS OF UNCONFINED
COMPRESSION TESTS
RECONSTITUTED SAND
SAMPLES GROUTED
IN THE LABORATORY

FOUNDATION INVESTIGATION AND TEST PROGRAM

EXISTING LOCKS AND DAM No. 26

ST LOUIS DISTRICT. CORPS OF ENGINEERS.

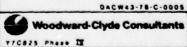
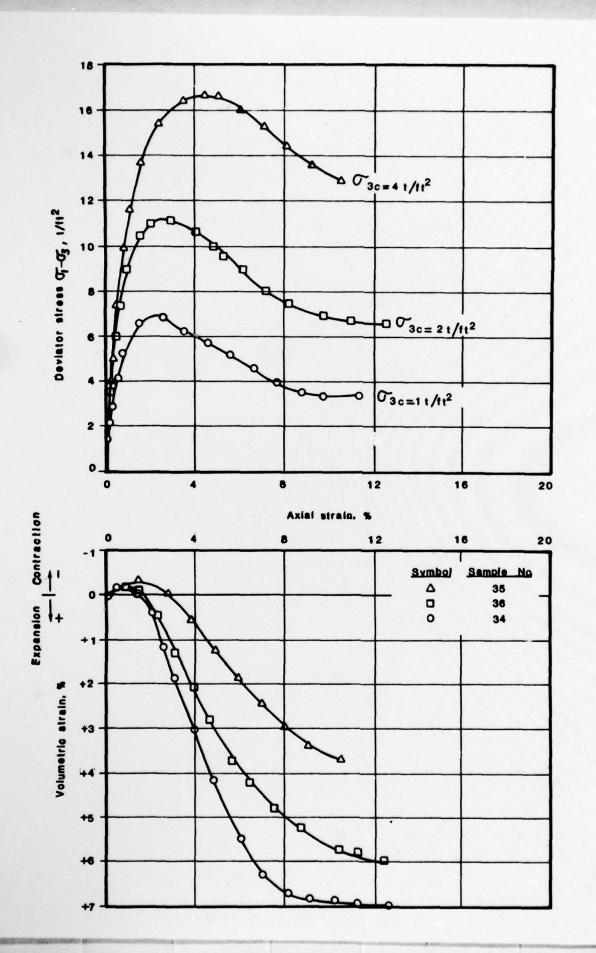
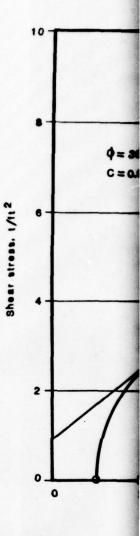


Fig. C.2

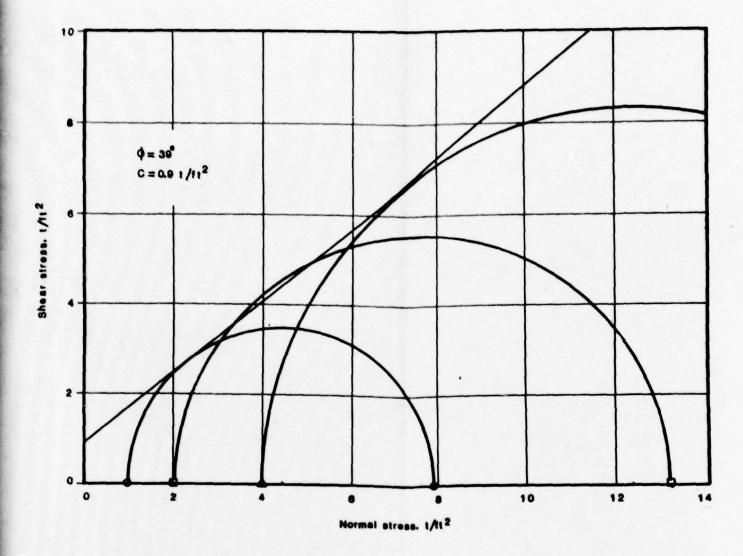




## Notes'

- I Axial st
- 2 Sand sam Dr-70% [
- 3 Sand sam and 6.6- is
- 4. Grout was following Sodius

Forma Sodius Water



#### Notes.

- 1 Axial strain rate 0.5 %/min
- 2 Sand samples were reconstituted at Dr-70% (8d 108-1b/1t3)
- 3. Sand samples were 2.8- in.-dia and 6.6- in.-high
- 4. Grout was 35 %Siroc 142 with the following composition (by volume)

Sodium Silicate 35%
Formamide 6%
Sodium Aluminate 0.15 lb/gal
Water 58%



CHEMICAL GROUTING TEST PROGRAM

RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
RECONSTITUTED SAND
SAMPLES GROUTED
IN THE LABORATORY
7-DAY CURING TIME

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0065

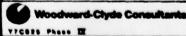
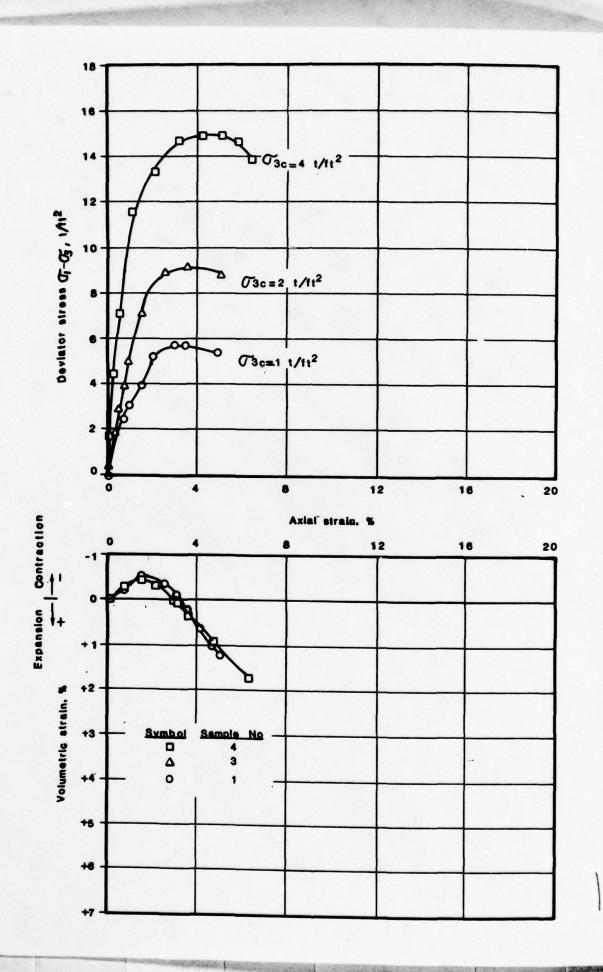


Fig. C.3

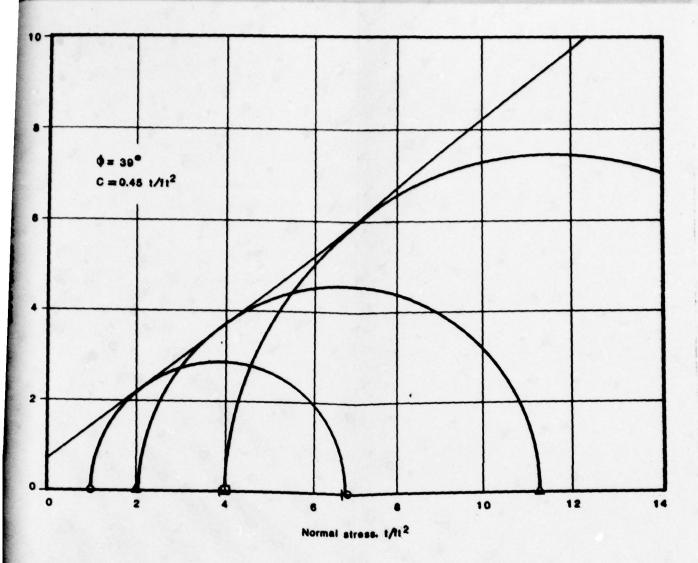




1 A

2 Se

4. Gr



#### Notes'

- t Axial strain rate 0.5 %/min
- 2 Sand samples were reconstituted at Dr-70% (8d 108-1b/ft3)
- 3 Sand samples were 2.8- in.-dia and 6.8- in.-high
- 4. Grout was 35 %Siroc 142 with the following composition (by volume)

Sodium Silicate 35%
Formamide 6%
Sodium Aluminate 0.15tb/gat
Water 58%



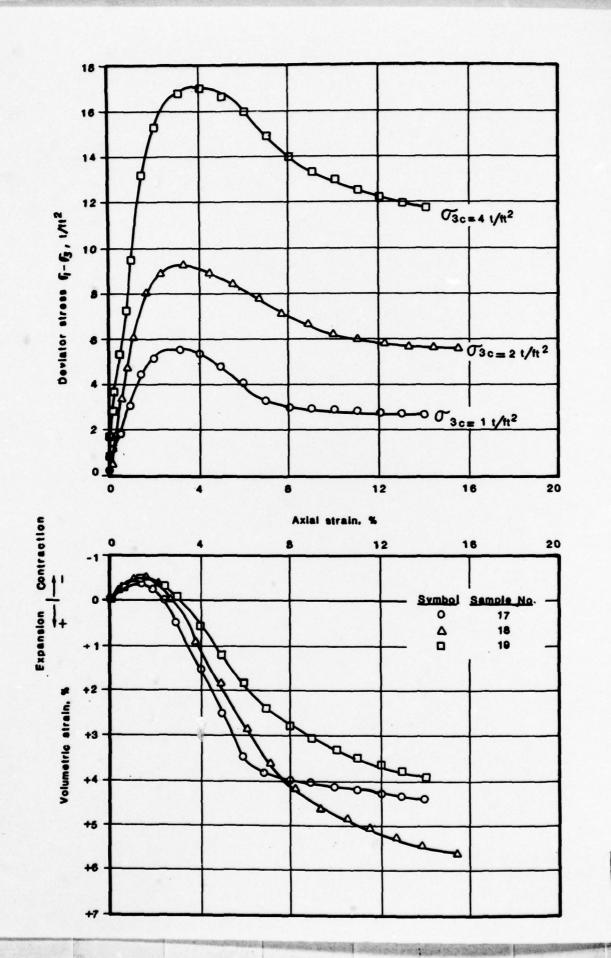
CHEMICAL GROUTING TEST PROGRAM

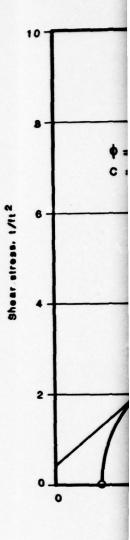
RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
RECONSTITUTED SAND
SAMPLES GROUTED
IN THE LABORATORY
7-DAY CURING TIME

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-75-C-0006

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Fig. C.4

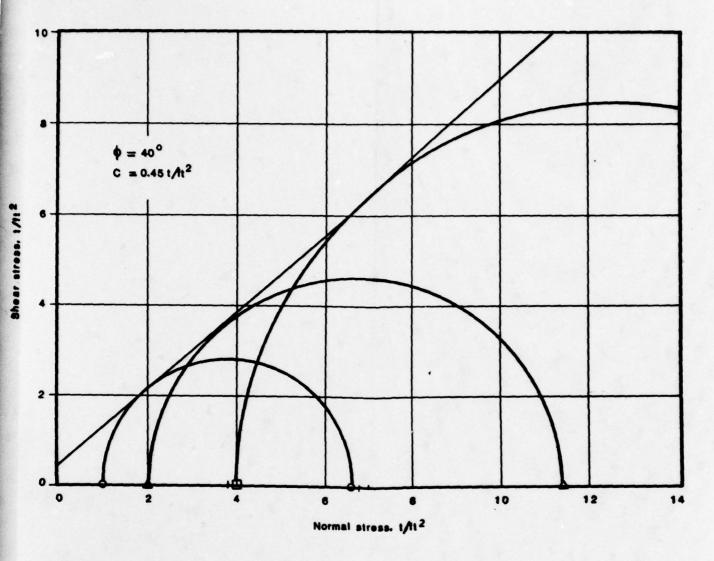




## Notes:

- I WXISI
- 2 Sand s Dr = 701
- 3 Sand s
- 4. Grout sollowi

For Sod Wa



## Notes'

- 1 Axial strain rate 0.5 %/min
- 2 Sand samples were reconstituted at D<sub>r</sub>=70% (ed 108=1b/ft<sup>3</sup>)
- 3. Sand samples were 2.8- in.-dia and 6.6- in.-high
- 4. Grout was 35 %Siroc 142 with the following composition (by volume)

Sodium Silicate 35% Formamide 6% Sodium Aluminate 0.151b/gal Water 58%



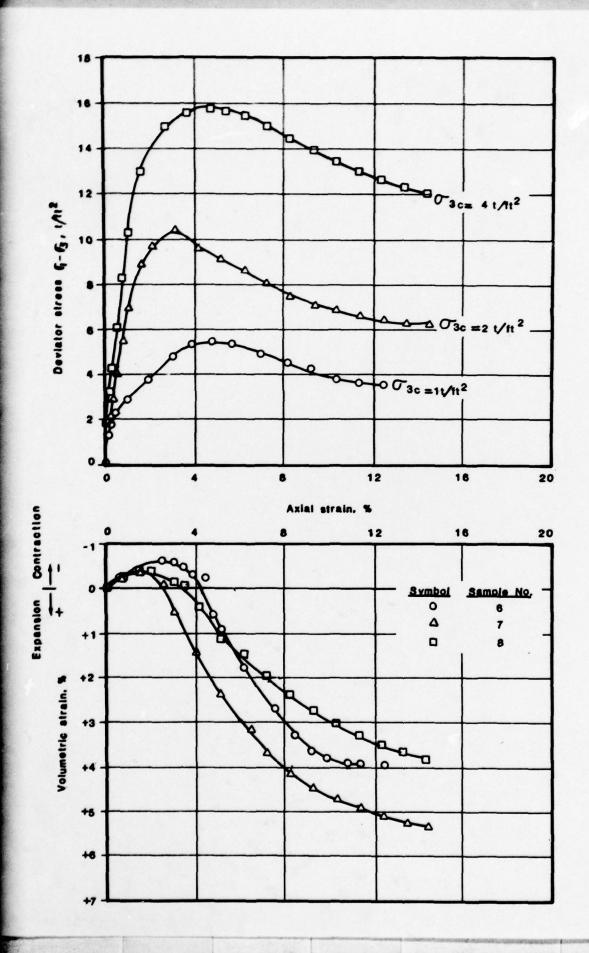
### CHEMICAL GROUTING TEST PROGRAM

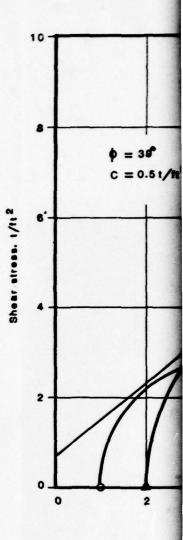
RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
RECONSTITUTED SAND
SAMPLES GROUTED
IN THE LABORATORY
28-DAY CURING TIME

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-8005

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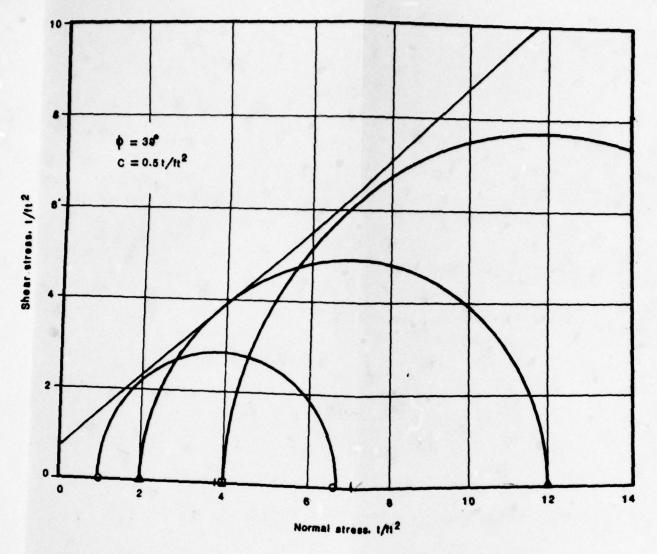
Fig. C.5





### Notes:

- 1 Axial strain re
- 2 Sand samples u D<sub>r</sub>=70% (8d 108
- 3 Sand samples and 6.6- in.-high
- 4. Grout was 35 % following comp Sodium Silic Formamide Sodium Alum Water



## Notes

- 1 Axial strain rate 0.5 %/min
- Sand samples were reconstituted at D<sub>r</sub>=70% (8d 108=1b/ft3)
- 3. Sand samples were 2.8- in.-dia and 6.6- in.-high
- 4. Grout was 35 % Siroc 142 with the following composition (by volume)

Sodium Silicate 35%
Formamide 6%
Sodium Aluminate 0.151b/gal
Water 58%



CHEMICAL GROUTING TEST PROGRAM

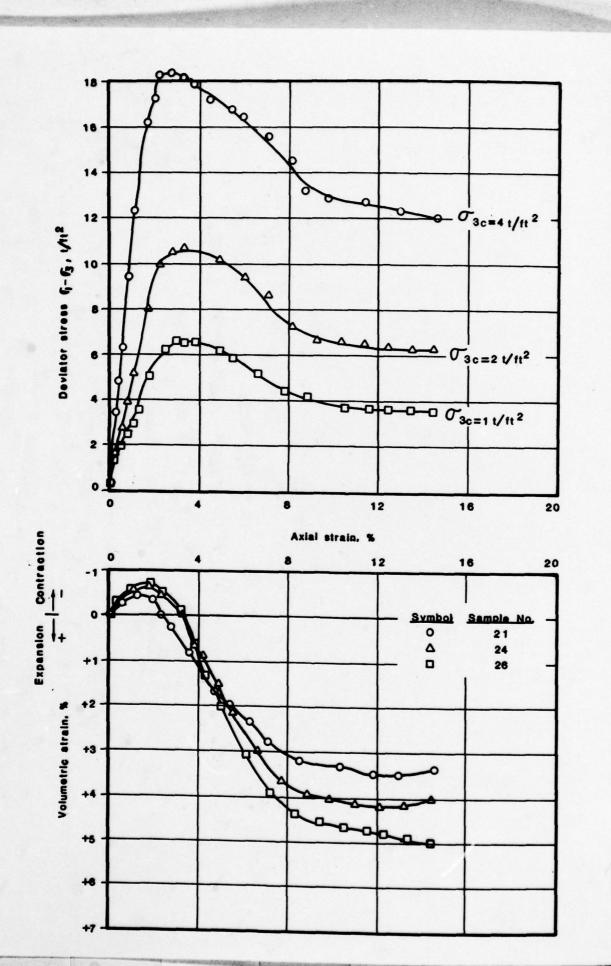
RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
RECONSTITUTED SAND
SAMPLES GROUTED
IN THE LABORATORY
28-DAY CURING TIME

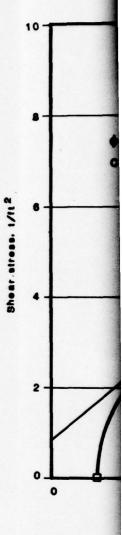
FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 28 ST LOUIS DISTRICT, CORPS OF ENGINEERS.

DACW43-78-C-0008

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Fig C.6

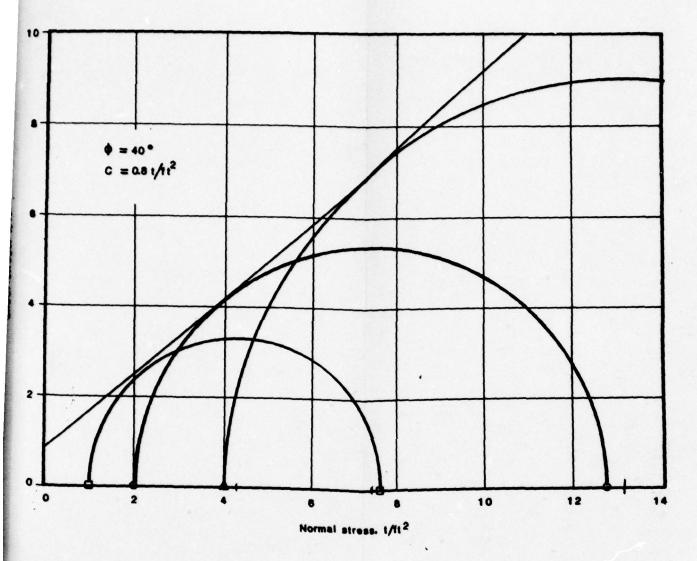




### Notes:

- 1 Axial
- 2 Sand a Dr = 701
- 3 Sand sand 6.6
- 4. Grout v

For Sod Wat



#### Notes'

- 1 Axial strain rate 0.5 %/min
- 2 Sand samples were reconstituted at Dr=70% (8d 108=1b/ft3)
- 3 Sand samples were 2.8- in.-dia and 6.6- in.-high
- 4. Grout was 35 %Siroc 142 with the following composition (by volume)

Sodium Silicate 35% Formamide 6% Sodium Aluminate 0.151b/gal Water 58% 0

CHEMICAL GROUTING TEST PROGRAM

RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
RECONSTITUTED SAND
SAMPLES GROUTED
IN THE LABORATORY
80-DAY CURING TIME

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT. CORPS OF ENGINEERS.

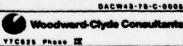
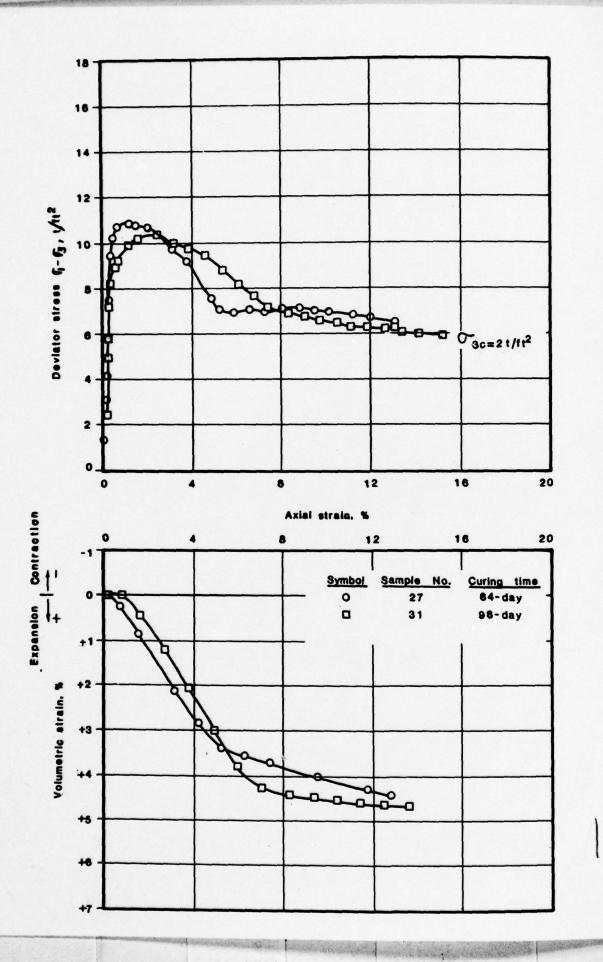
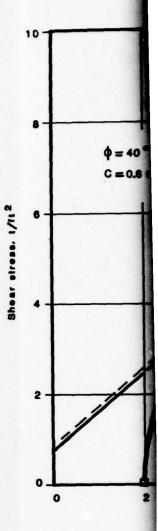


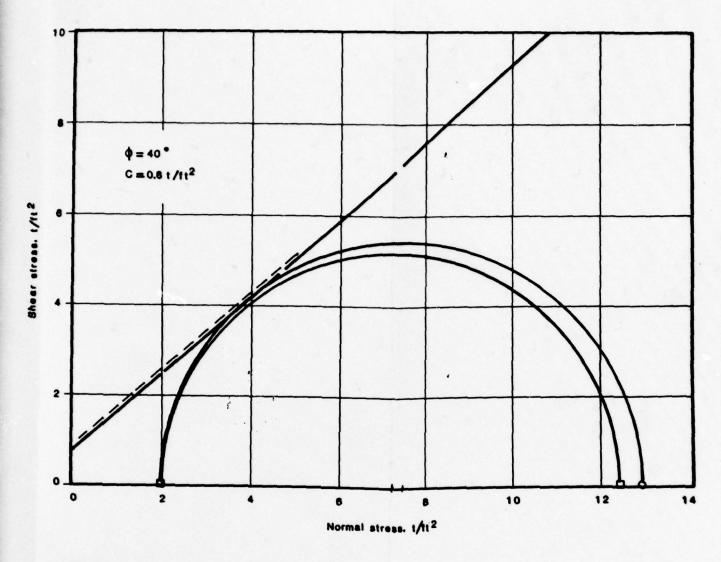
Fig C.7





### Notes:

- 1 Axial strate
- 2 Sand sample Dr-70% ldd
- 3 Sand sample and 6.6- in.
- 4. Grout was : following
  - Formami Sodium Water
- 5. Samples we after cree;



#### Notes:

- 1 Axial strain rate 0.5 %/min
- 2 Sand samples were reconstituted at D<sub>r</sub>=70% (ĕ<sub>d</sub> 108=1b/ft<sup>3</sup>)
- 3. Sand samples were 2.8- in.-dia and 6.6- in.-high
- 4. Grout was 35 %Siroc 142 with the following composition (by volume)

Sodium Silicate 35% Formamide 6% Sodium Aluminate 0.151b/gai Water 58%

5. Samples were tested to failure after creep tests



CHEMICAL GROUTING TEST PROGRAM

RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
RECONSTITUTED SAND
SAMPLES GROUTED
IN THE LABORATORY
84-DAY CURING TIME

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.
DACW43-78-C-0008

Woodward-Chyde Consultants

Fig C.8

# PHASE IV REPORT VOLUME IIA

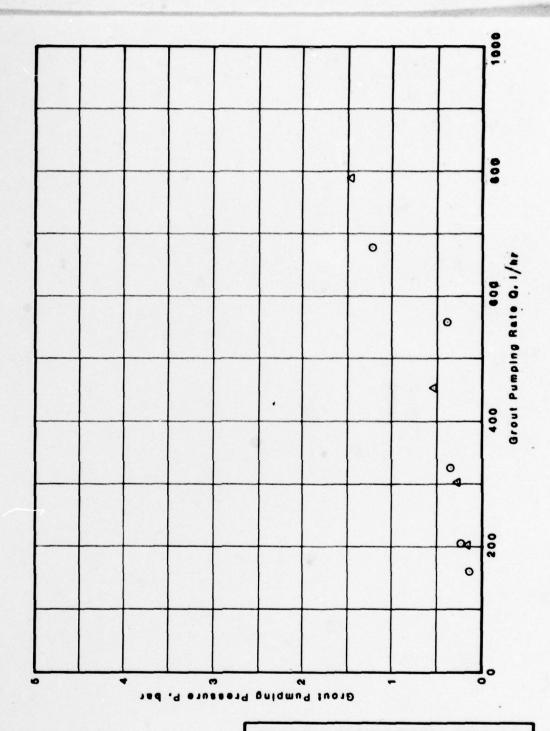
RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM

APPENDIX D
GROUTING PROCEDURES

## APPENDIX D GROUTING PROCEDURES

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Figure D.1 through Figure D.11 RESULTS OF HYDRAULIC FRACTURING TESTS



Symbol Test el

0 380.0

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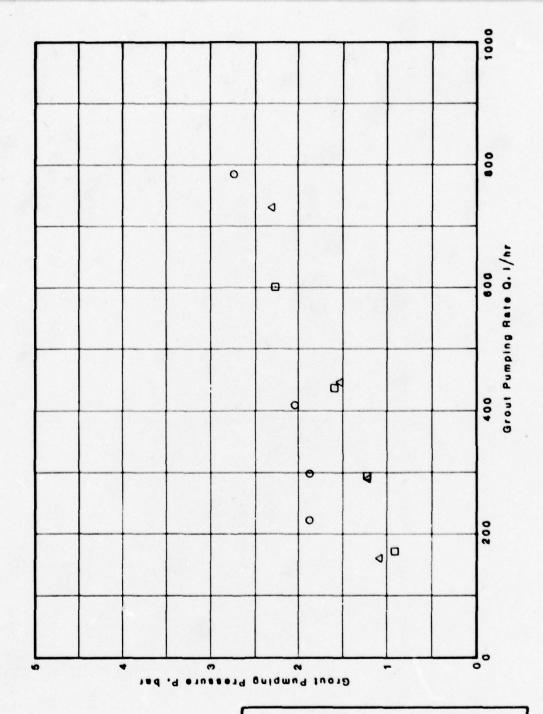
CHEMICAL GROUTING TEST PROGRAM

FRACTURING TEST
GROUT HOLE NO.3-3

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

0AC 441-71-G-0005

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## CHEMICAL GROUTING TEST PROGRAM

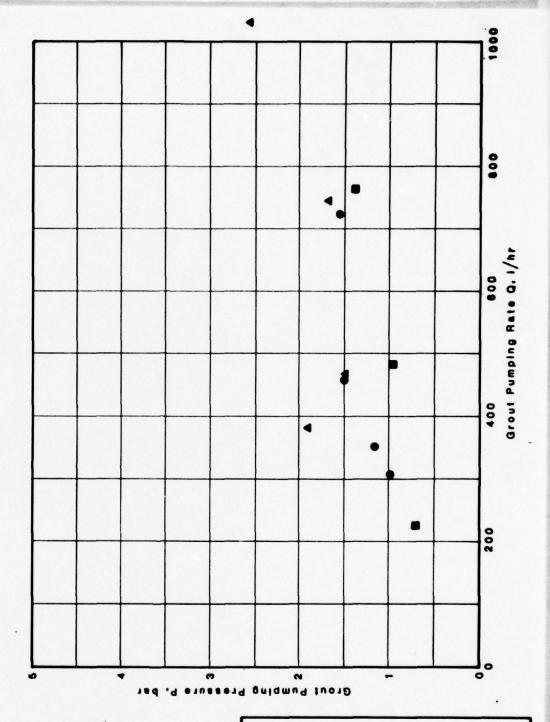
RESULTS OF HYDRAULIC FRACTURING TEST **GROUT HOLE NO.4-2** 

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26

ST LOUIS DISTRICT. CORPS OF ENGINEERS

0AC#41-74-C-0005

) Woodward-Clyde Consultants Fig. D.2



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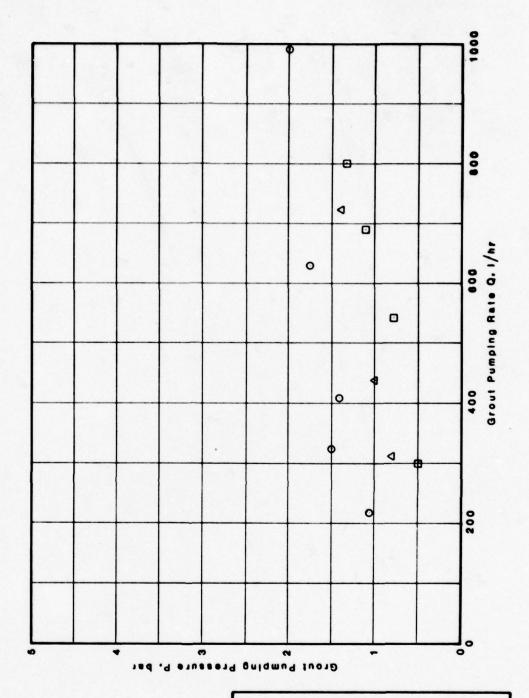
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CHEMICAL GROUTING TEST PROGRAM

RESULTS OF HYDRAULIC FRACTURING TEST GROUT HOLE NO.6-1

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

Woodward-Clyde Consultants



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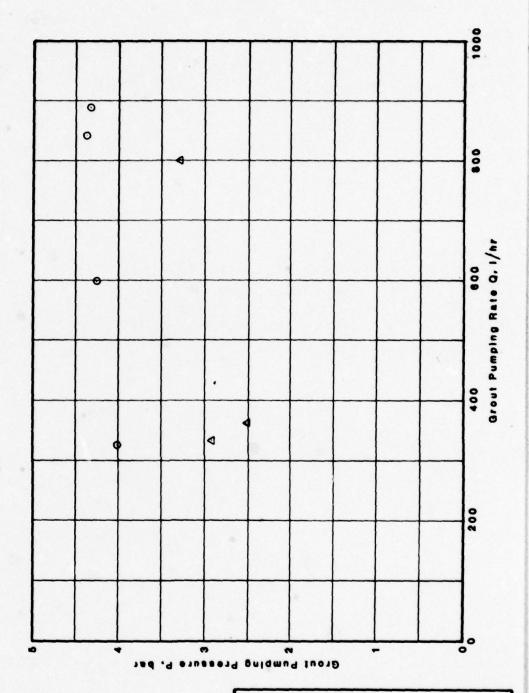
## CHEMICAL GROUTING TEST PROGRAM

RESULTS OF HYDRAULIC FRACTURING TEST GROUT HOLE NO.6-3

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 28
ST. LOUIS DISTRICT, CORPS OF ENGINEERS

DAC#43-78-C-0005

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## CHEMICAL GROUTING TEST PROGRAM

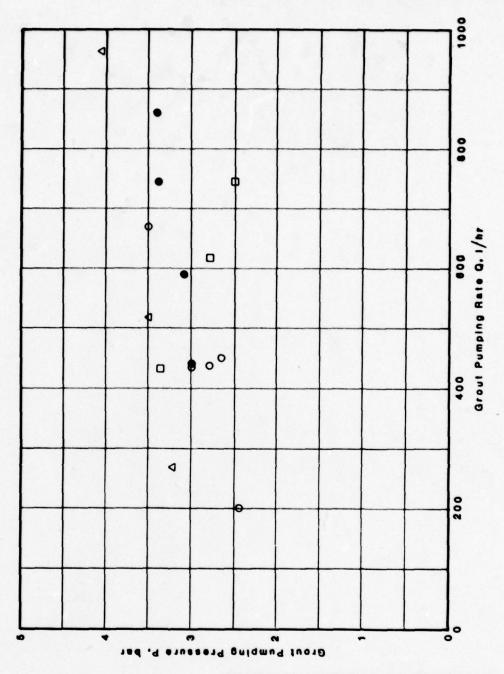
RESULTS OF HYDRAULIC FRACTURING TEST GROUT HOLE NO.7-1

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

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Fig. D.5

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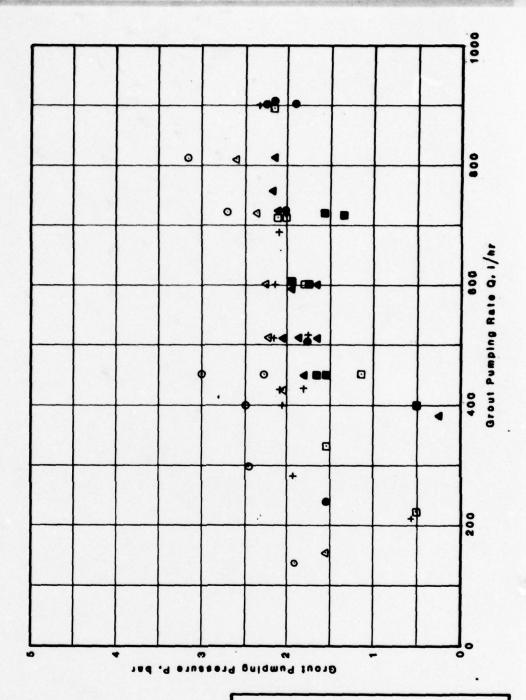
386.6

## CHEMICAL GROUTING TEST PROGRAM

RESULTS OF HYDRAULIC FRACTURING TEST **GROUT HOLE NO.7-2** 

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAW No. 26 ST LOUIS DISTRICT. CORPS OF EN INCERS.

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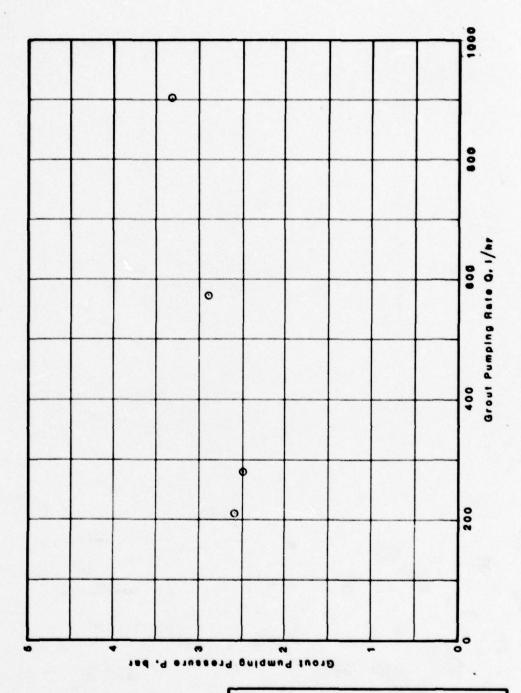
## CHEMICAL GROUTING TEST PROGRAM

RESULTS OF HYDRAULIC FRACTURING TEST GROUT HOLE NO.10-2

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26 ST LOUIS DISTRICT. CORPS OF ENGINEERS.

DACW43-78-C-0008

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## CHEMICAL GROUTING TEST PROGRAM

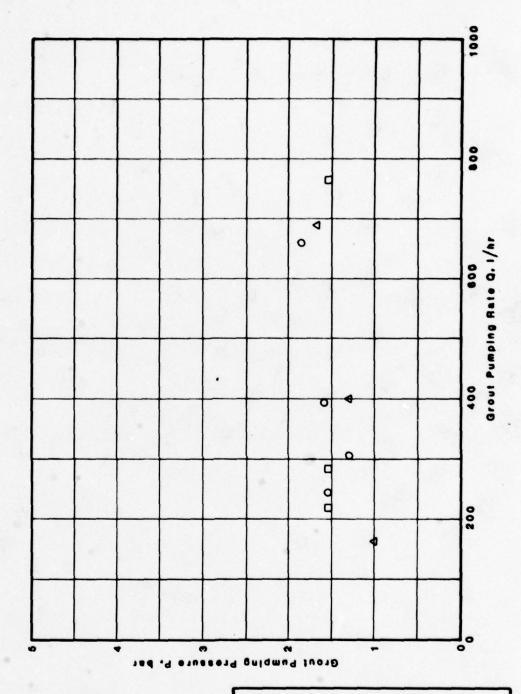
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FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAW No. 26

ST LOUIS DISTRICT. CORPS OF ENGINEERS.

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Woodward-Clyde Consultants



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## CHEMICAL GROUTING TEST PROGRAM

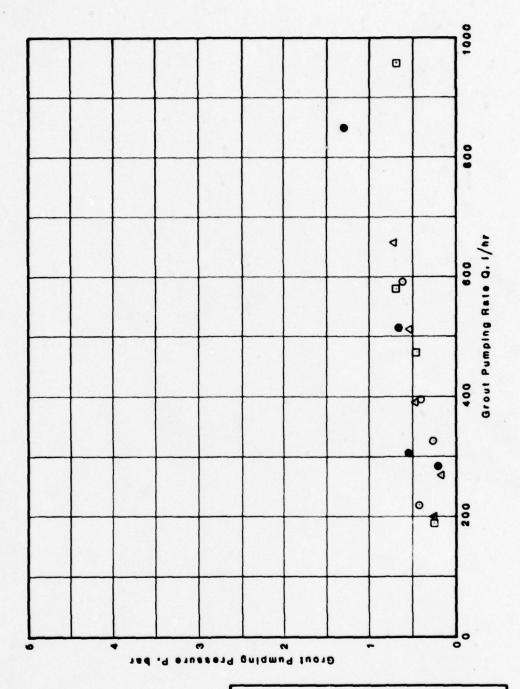
RESULTS OF HYDRAULIC FRACTURING TEST GROUT HOLE NO.12-2

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26

ST LOUIS DISTRICT, CORPS OF ENGINEERS. DACH43-75-C-3005

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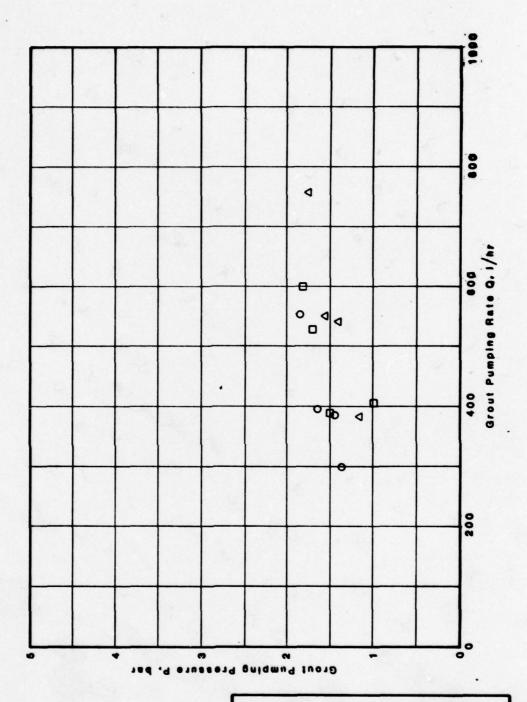
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CHEMICAL GROUTING TEST PROGRAM

RESULTS OF HYDRAULIC FRACTURING TEST GROUT HOLE NO.12-4

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26 ST LOUIS DISTRICT. CORES OF ENGINEERS.

040443-14-0 1021 Woodward Clyde Consultants Fig. D. 10



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CHEMICAL GROUTING TEST PROGRAM

RESULTS OF HYDRAULIC FRACTURING TEST GROUT HOLE NO.13-2

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 20

ST LOUIS DISTRICT, CORPS OF ENGINEERS. 340 W43-78-C-0008

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# PHASE IV REPORT VOLUME IIA

RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM

APPENDIX E
MONITORING OF GROUTING ACTIVITIES

## APPENDIX E MONITORING OF GROUTING ACTIVITIES

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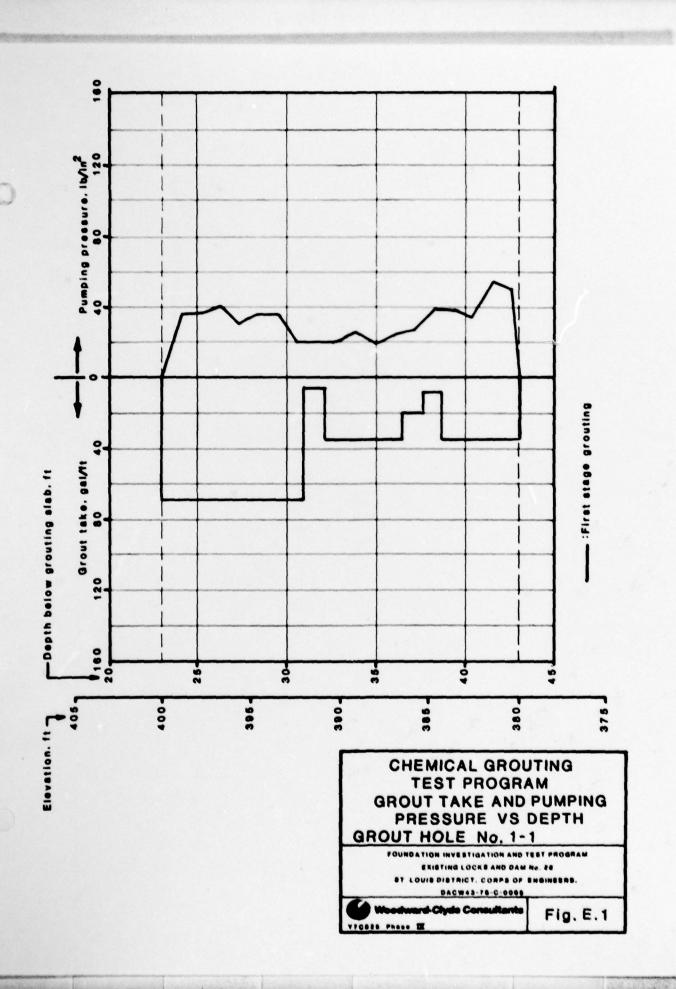
Figure E.1 through Figure E.7	GROUT TAKE AND PUMPING PRESSURE SUBAREA 1
Figure E.8 through Figure E.11	GROUT TAKE AND PUMPING PRESSURE SUBAREA 2
Figure E.12 through Figure E.15	GROUT TAKE AND PUMPING PRESSURE SUBAREA 3
Figure E.16 through Figure E.20	GROUT TAKE AND PUMPING PRESSURE SUBAREA 4
Figure E.21 through Figure E.24	GROUT TAKE AND PUMPING PRESSURE SUBAREA 5
Figure E.25 through Figure E.26	GROUT TAKE AND PUMPING PRESSURE SUBAREA 5a
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Figure E.32 through Figure E.37	GROUT TAKE AND PUMPING PRESSURE SUBAREA 7
Figure E.38 through Figure E.45	GROUT TAKE AND PUMPING PRESSURE SUBAREA 8

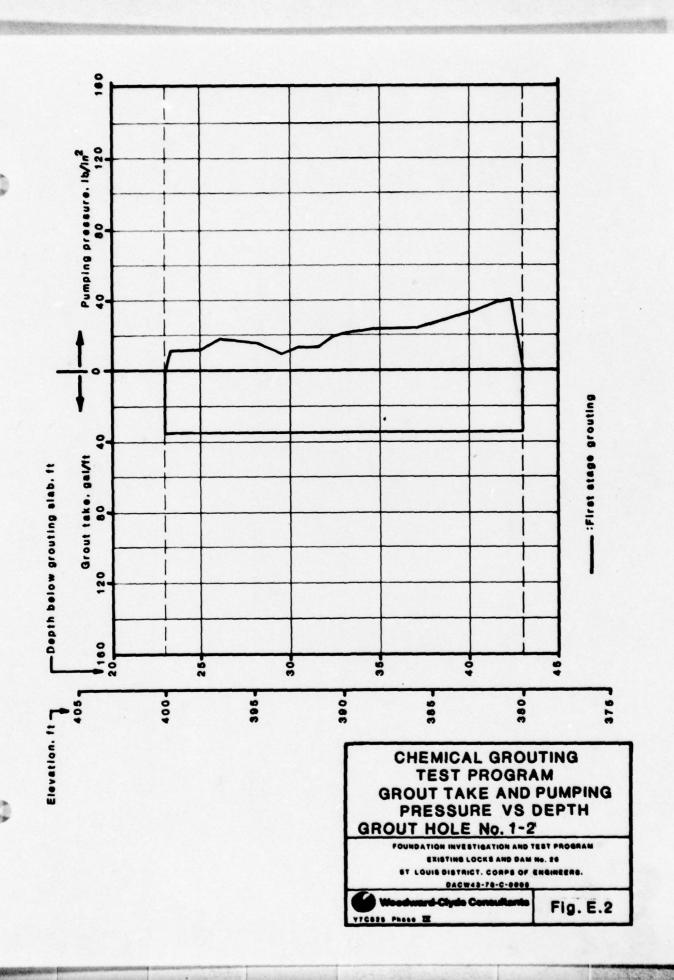
## APPENDIX E MONITORING OF GROUTING ACTIVITIES

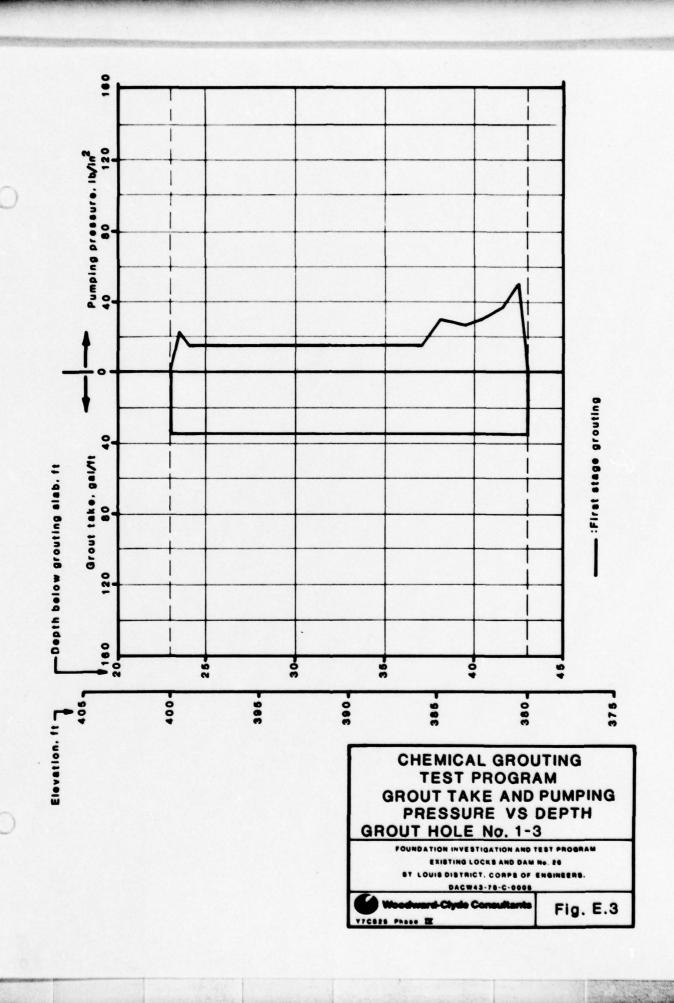
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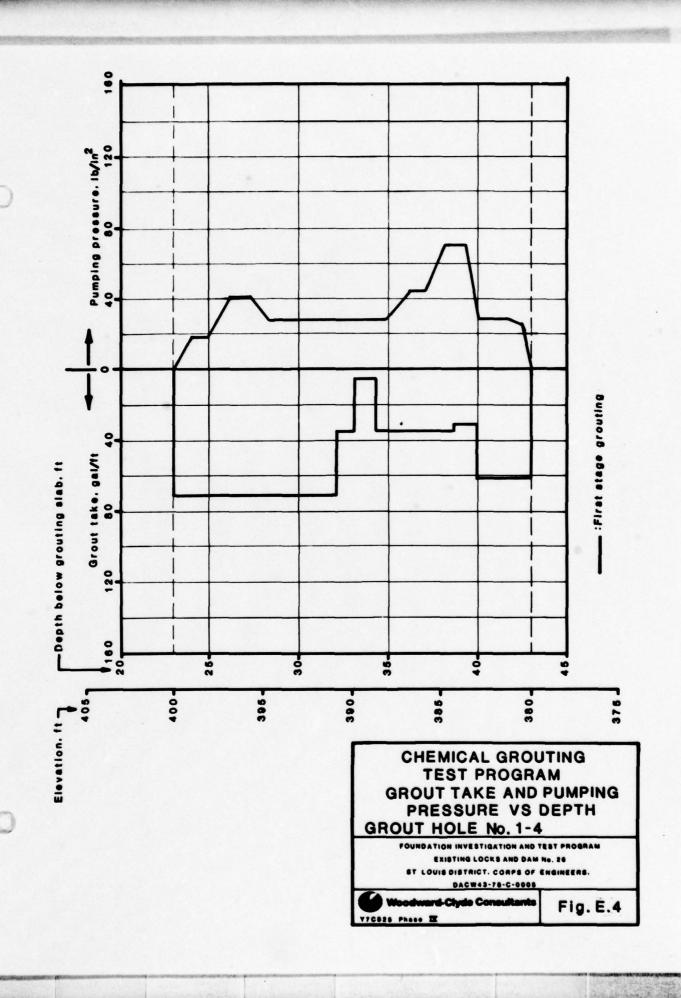
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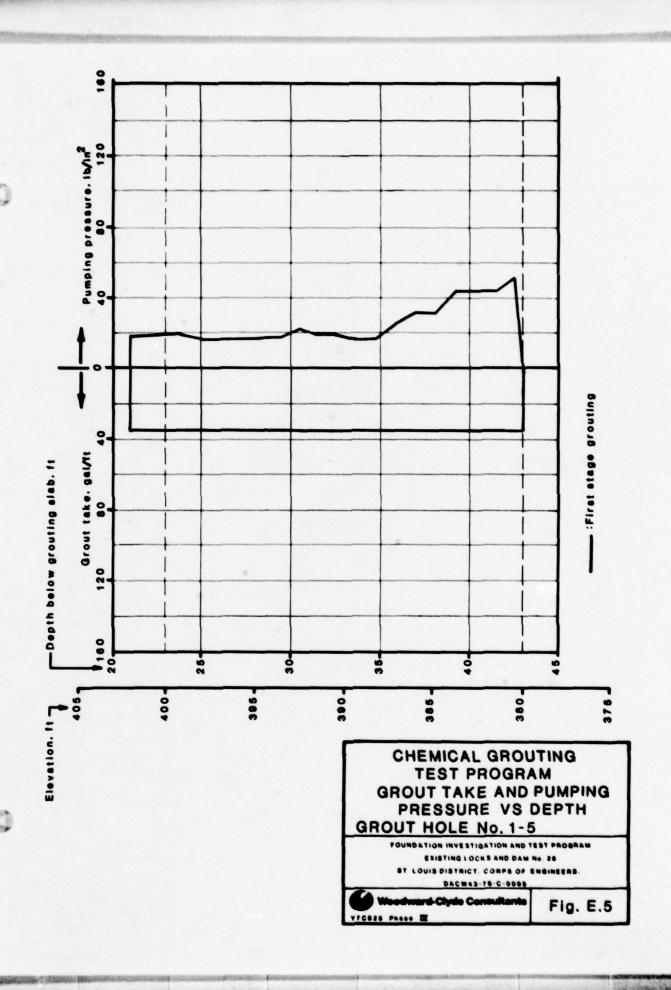
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Figure E.58 through Figure E.65	GROUT TAKE AND PUMPING PRESSURE SUBAREA 11
Figure E.66 through Figure E.69	GROUT TAKE AND PUMPING PRESSURE SUBAREA 12
Figure E.70 through Figure E.74	GROUT TAKE AND PUMPING PRESSURE SUBAREA 13

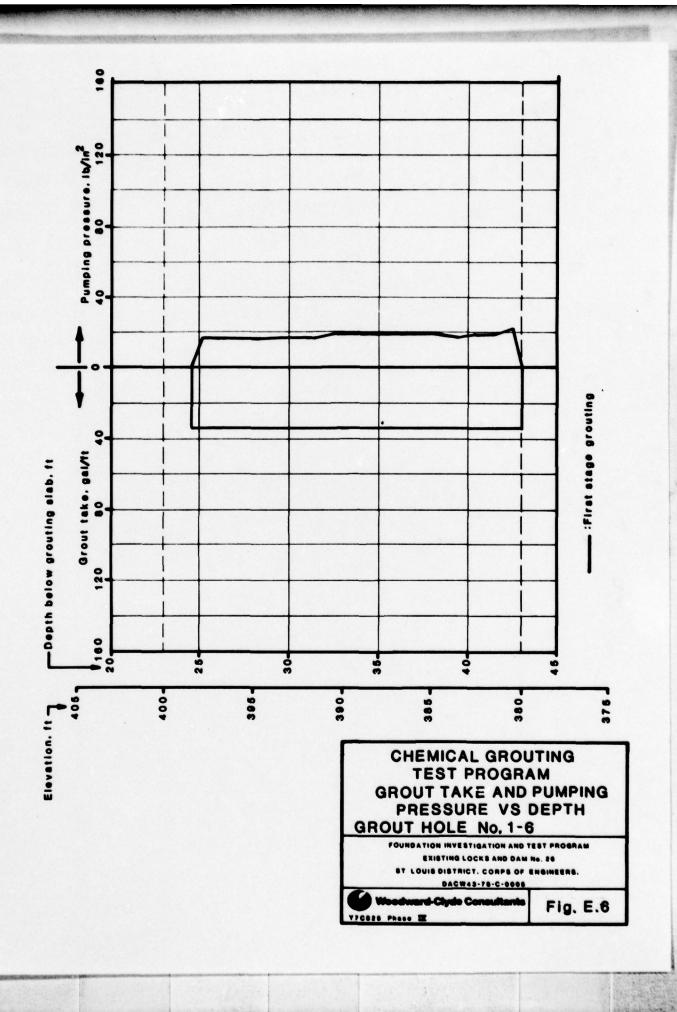


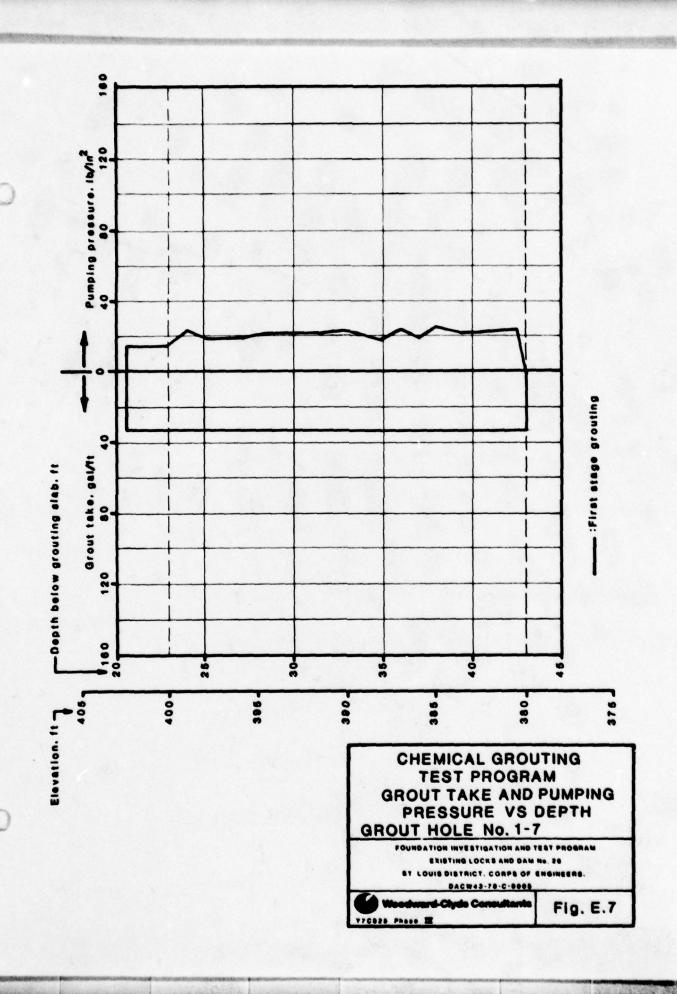


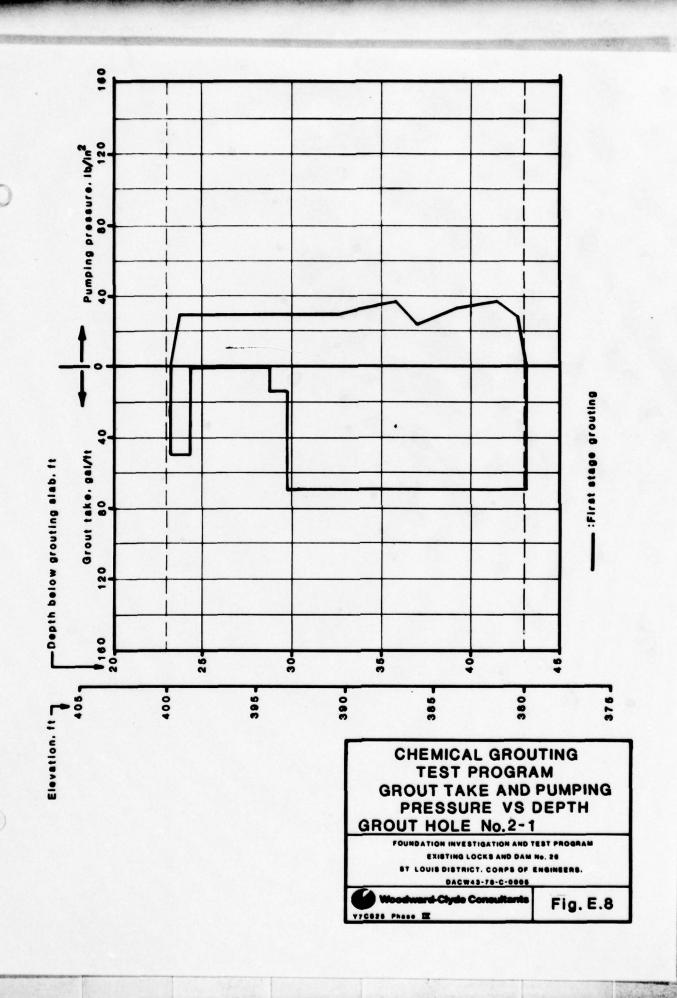


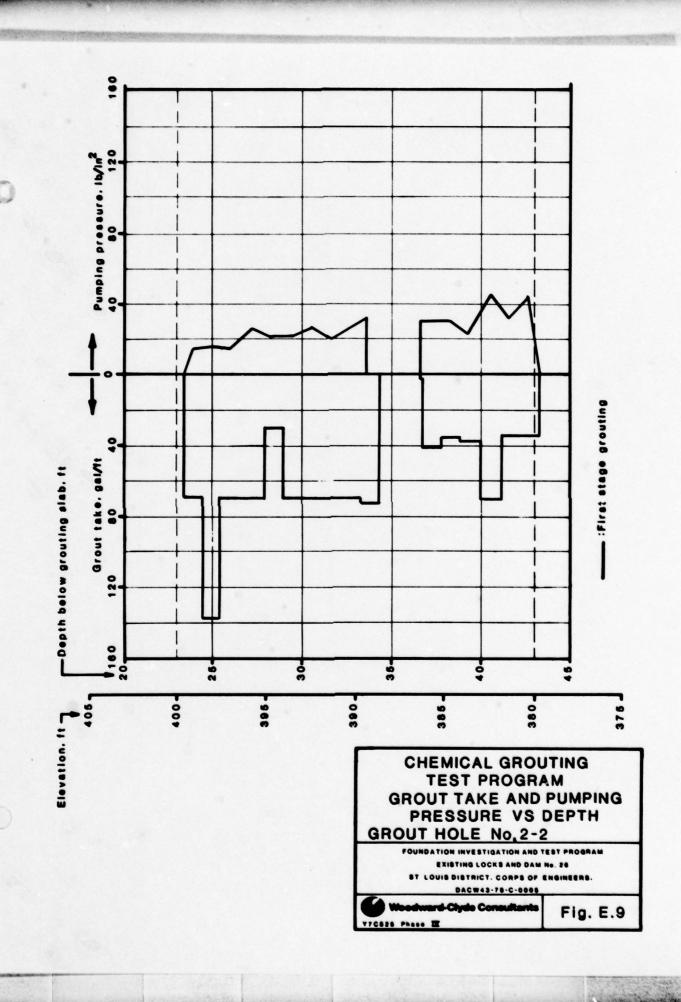


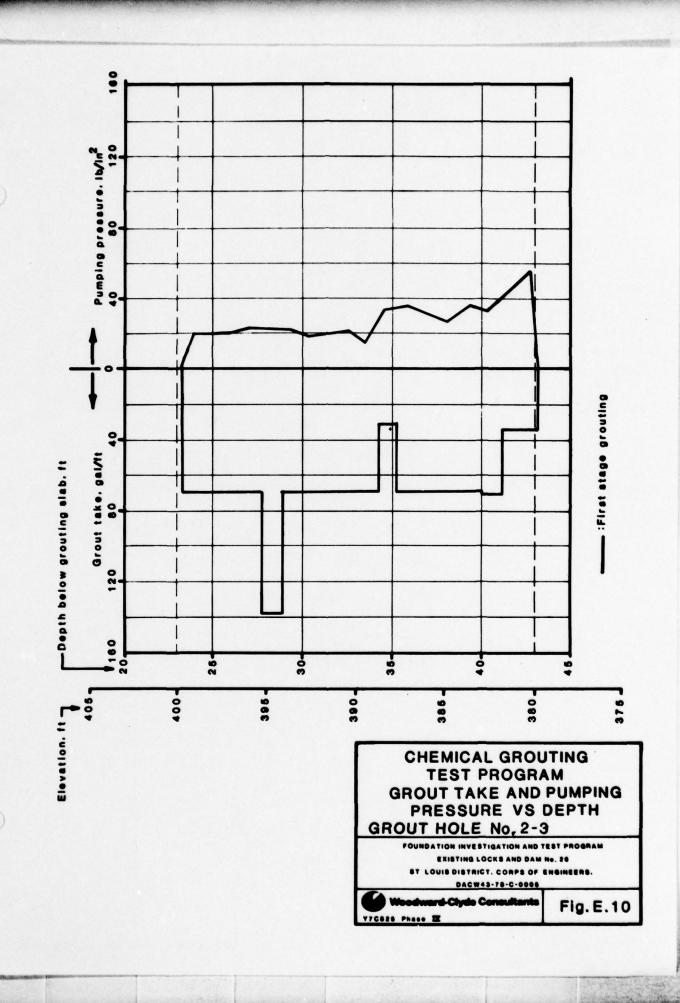


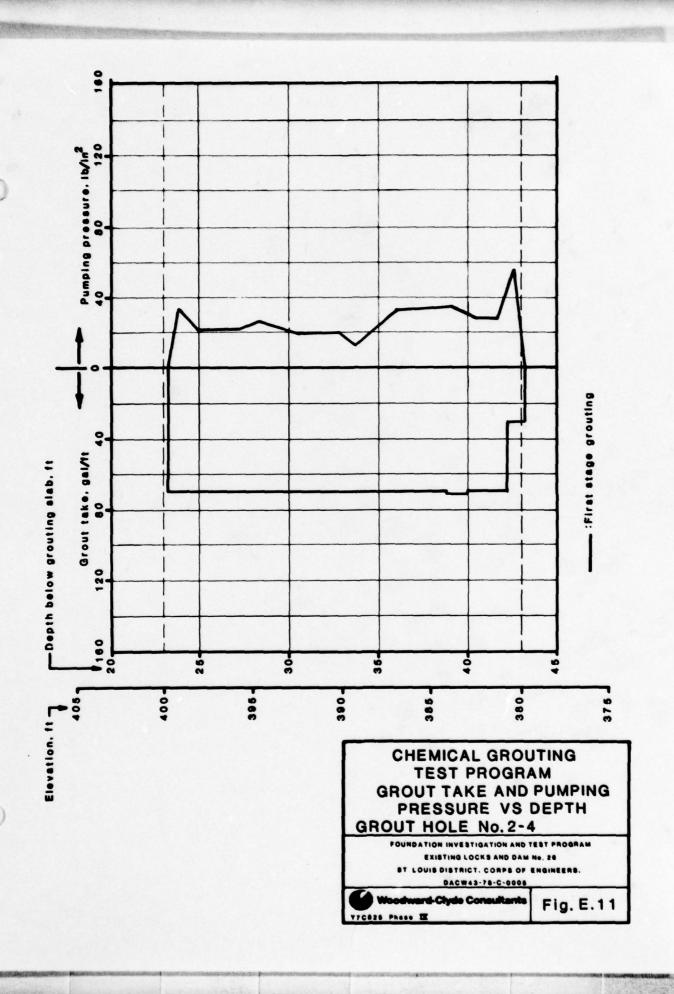


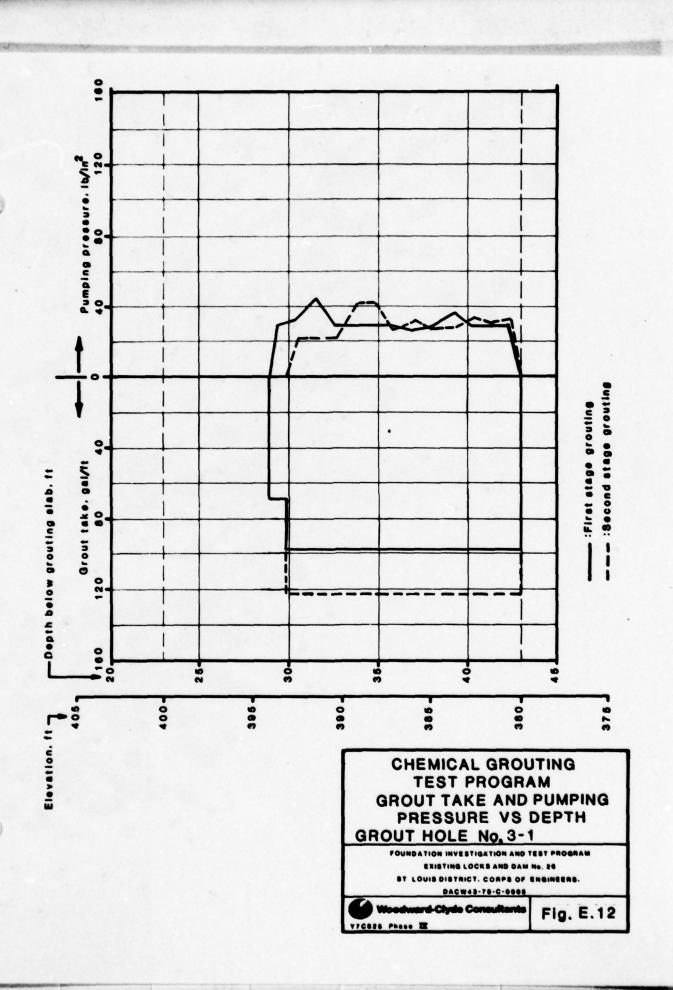


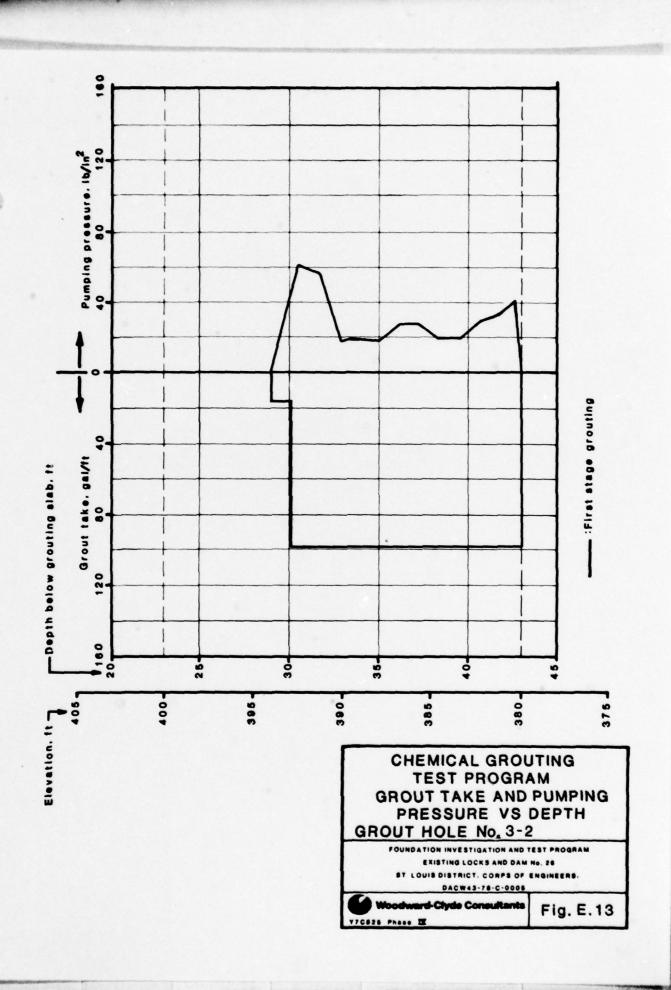


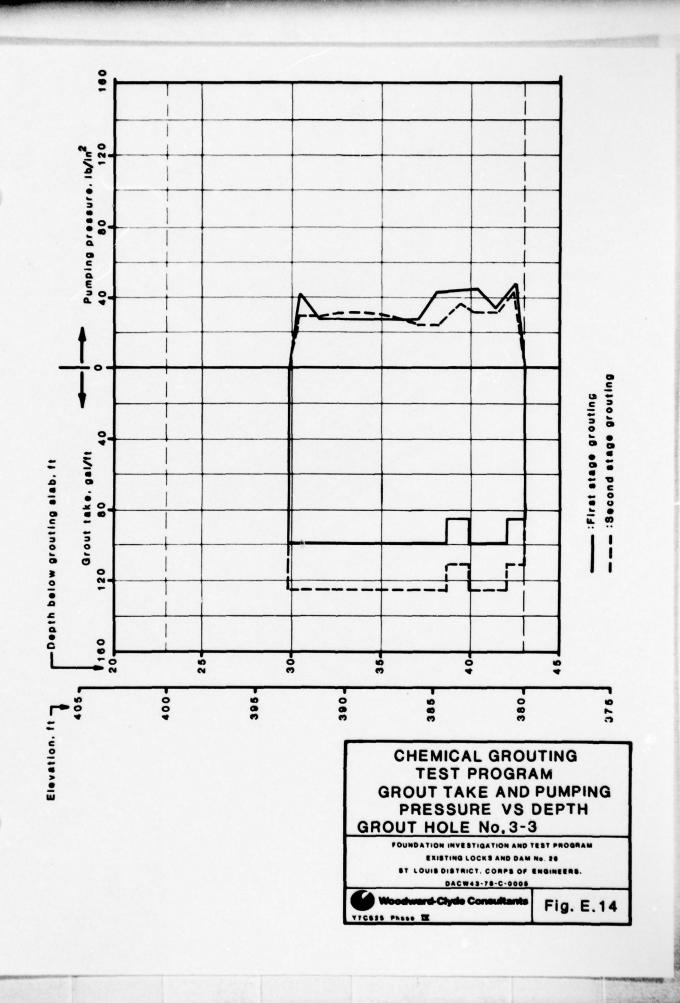


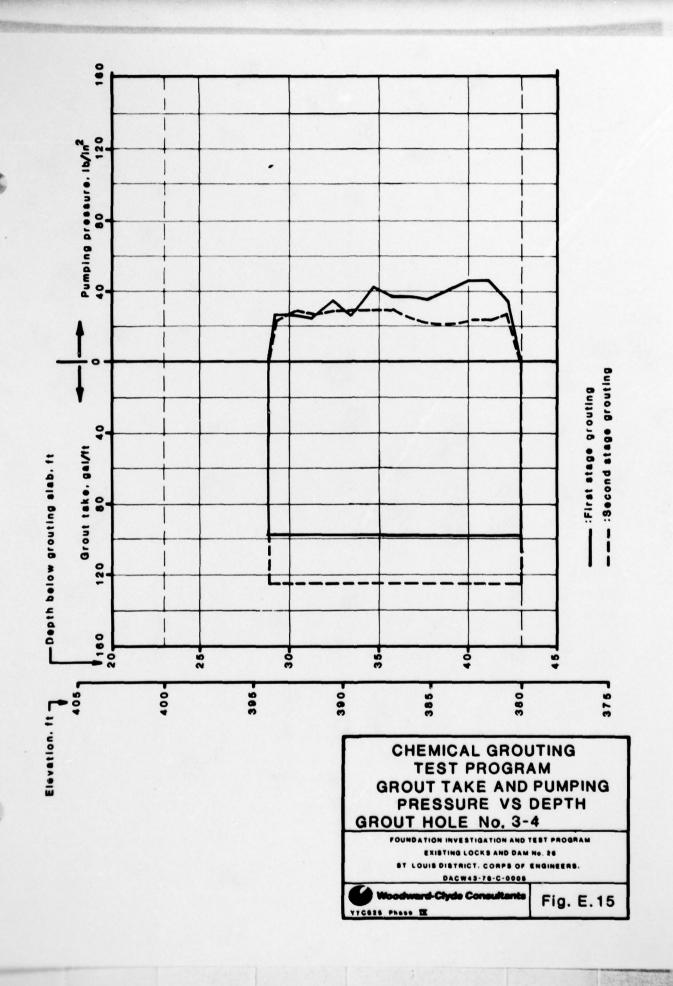


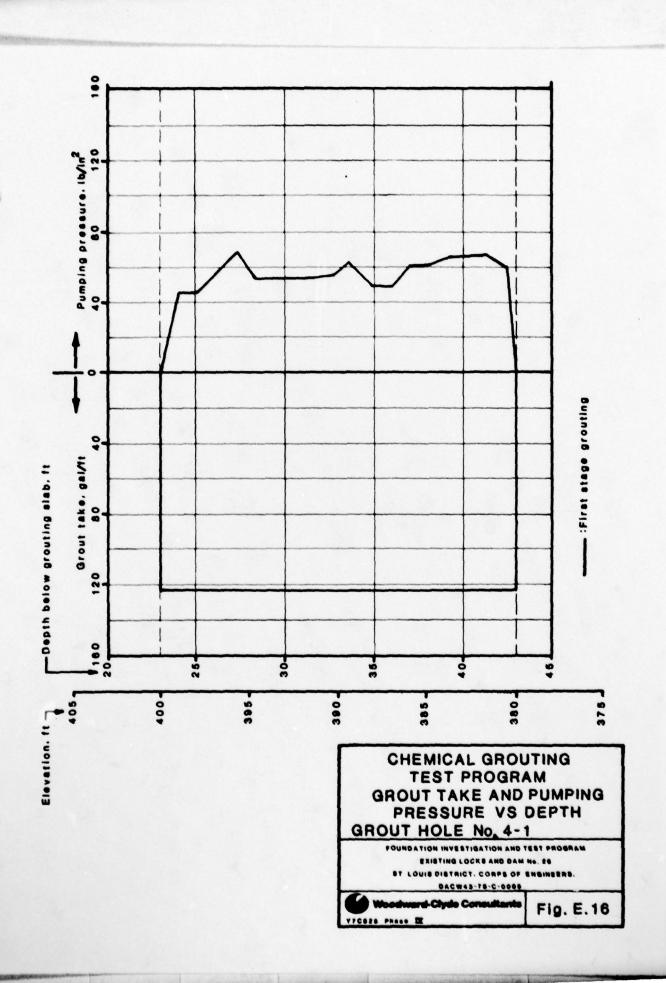


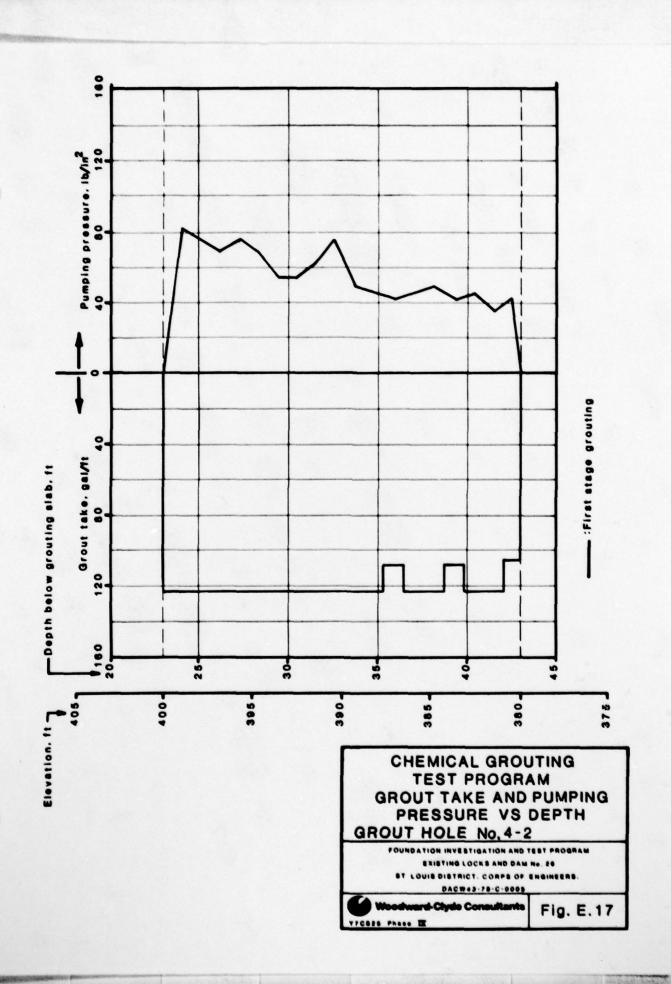


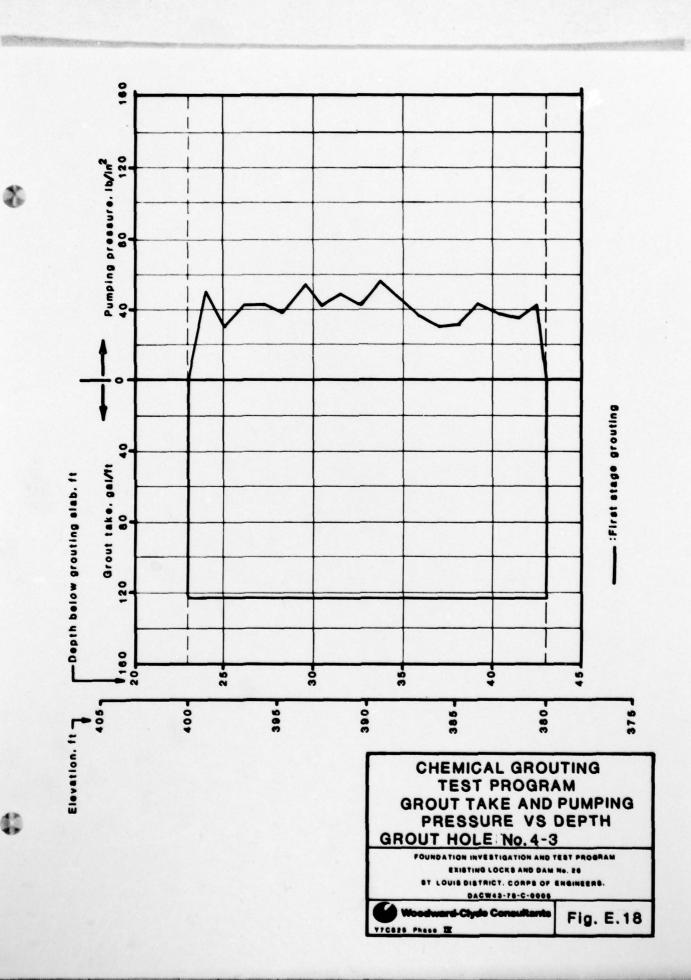


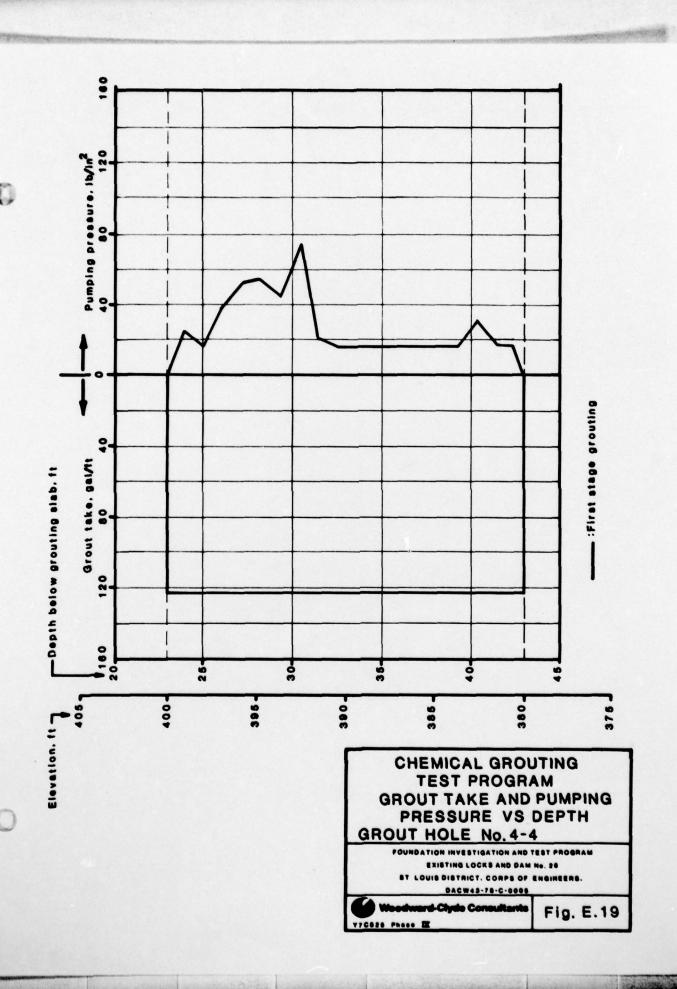


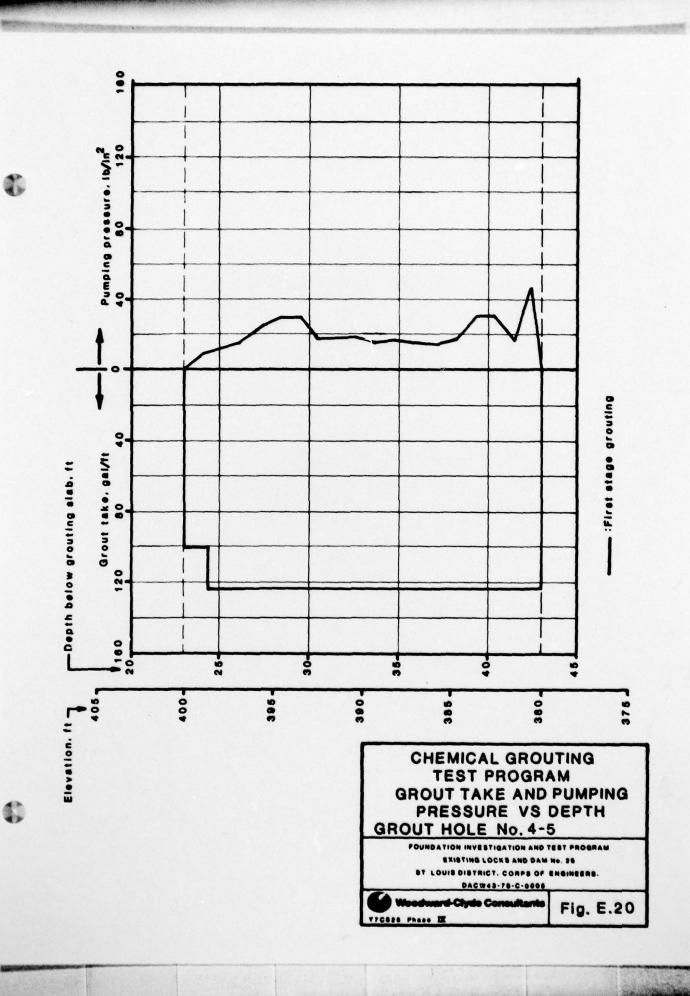


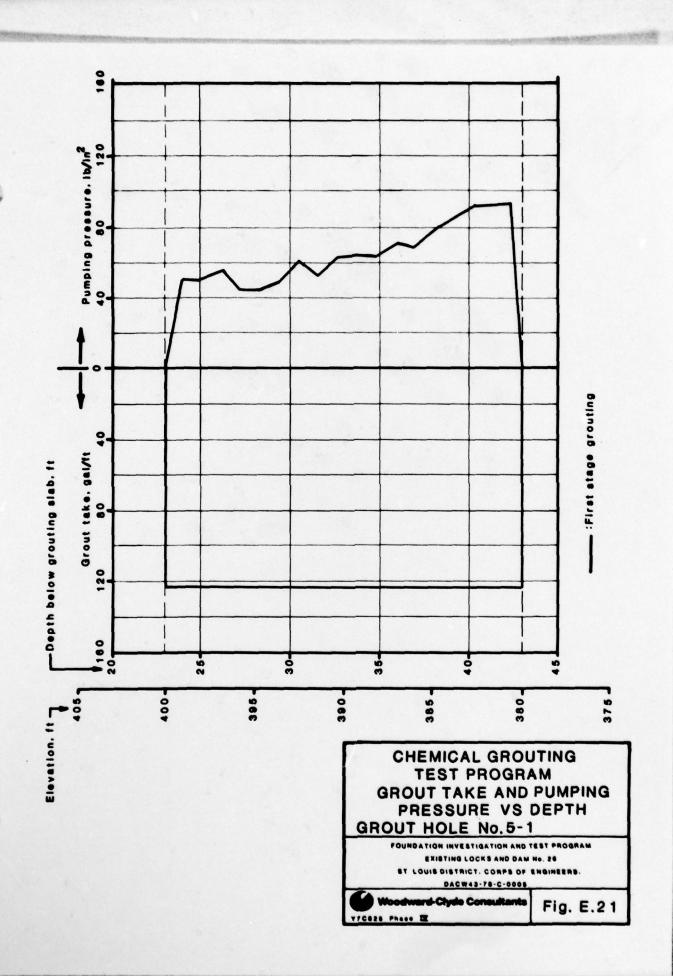


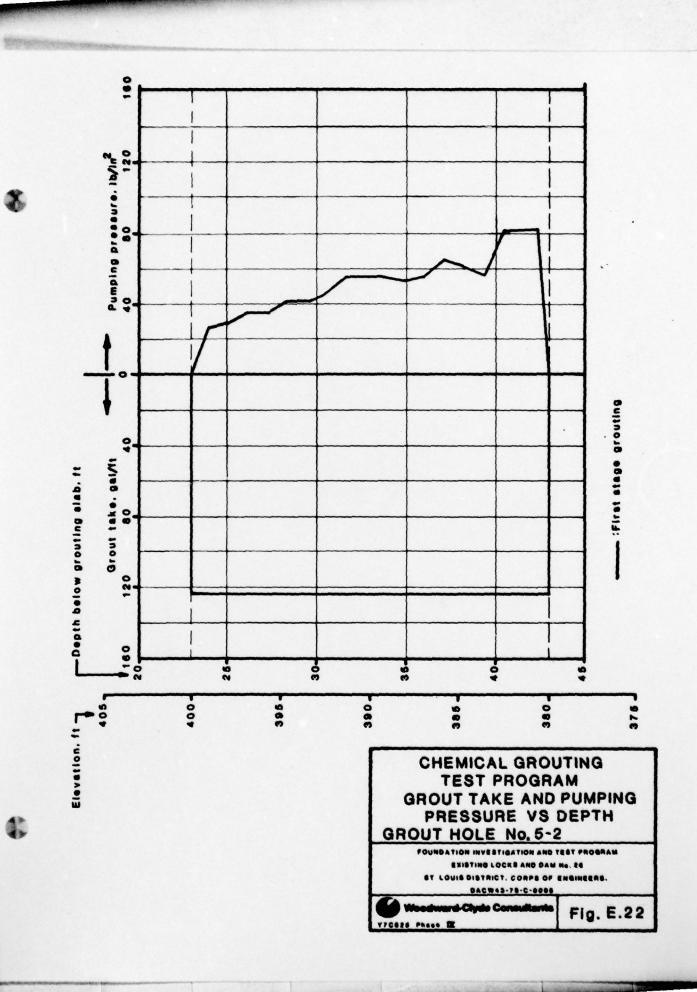


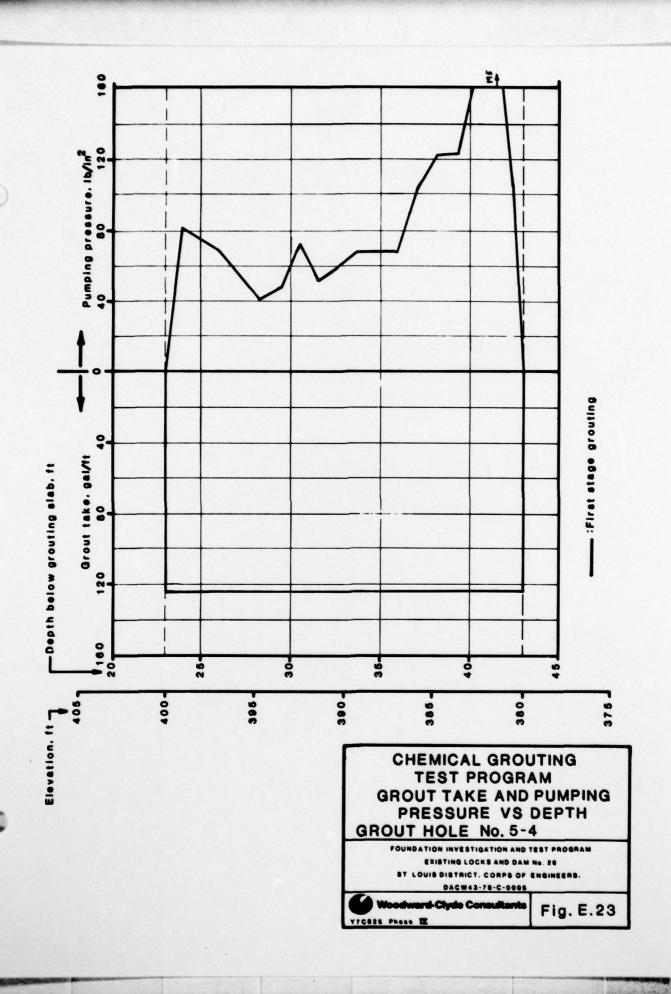


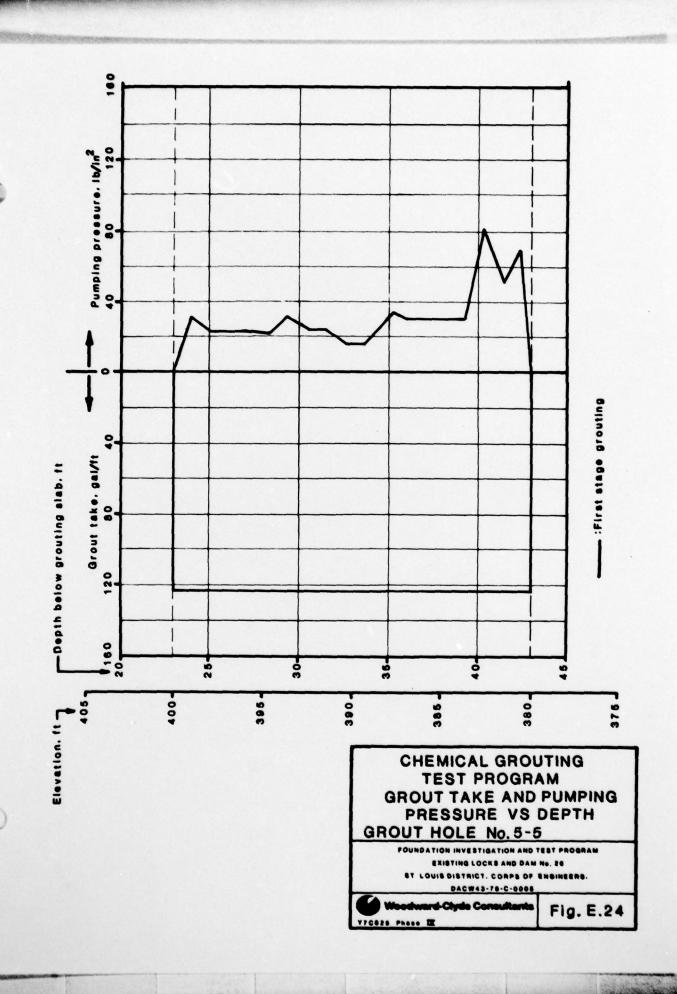


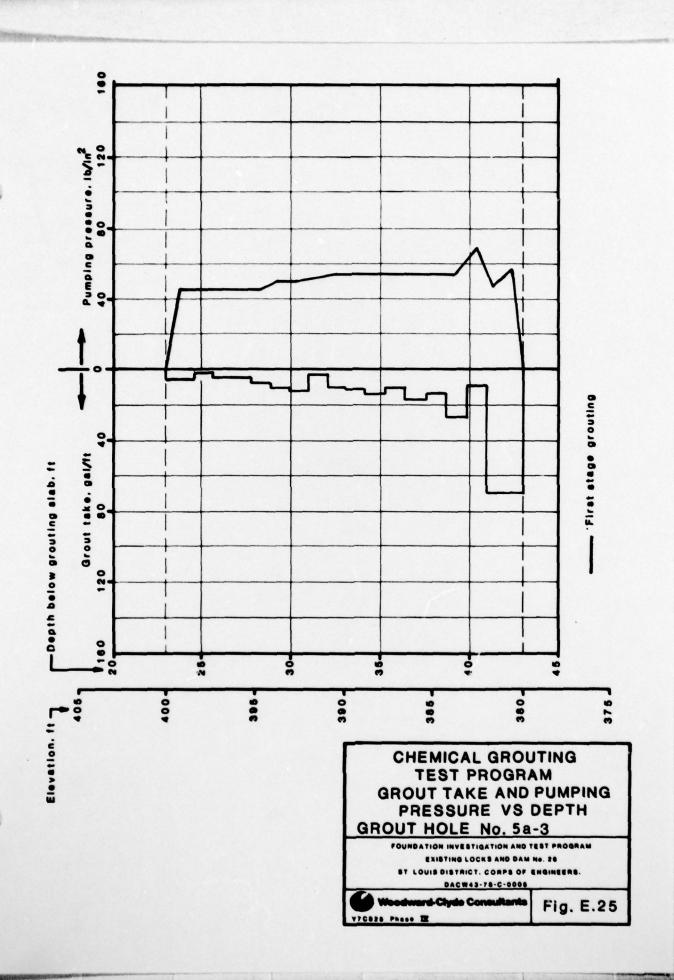


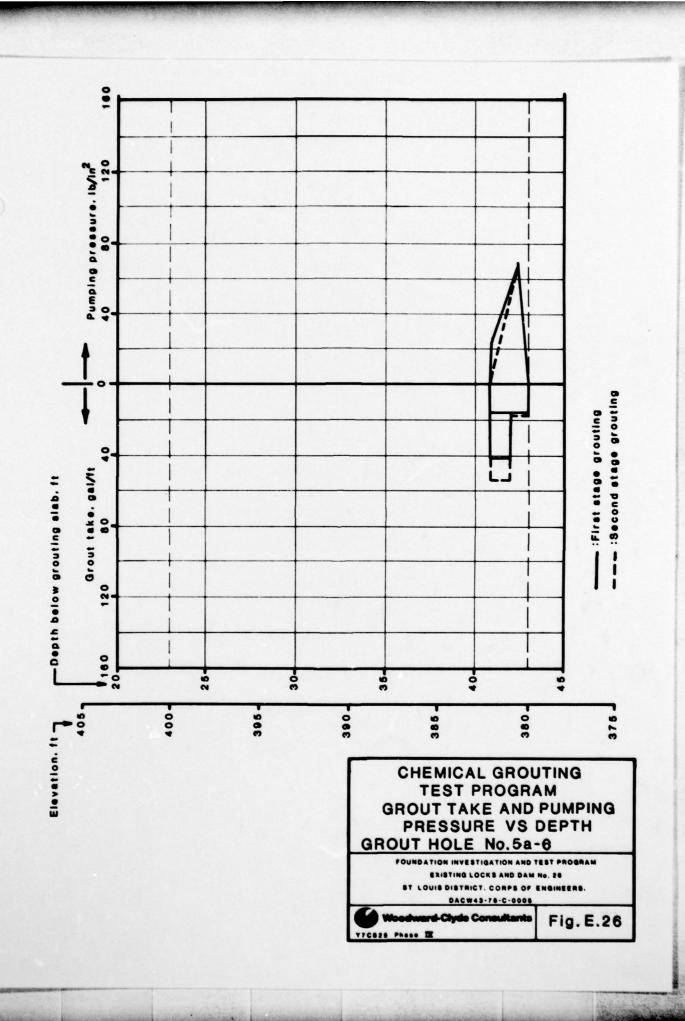


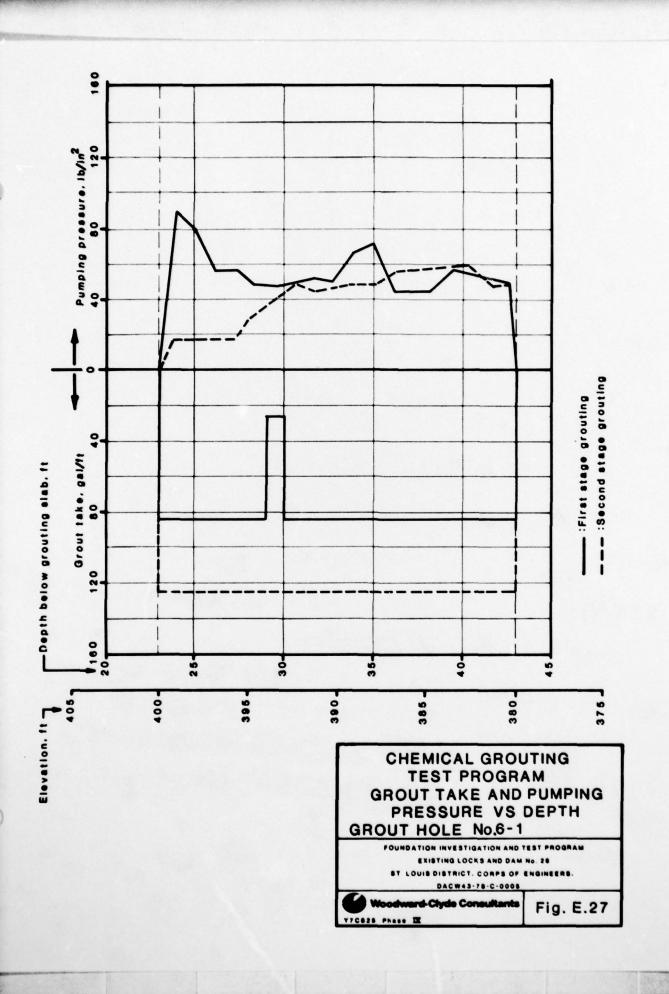


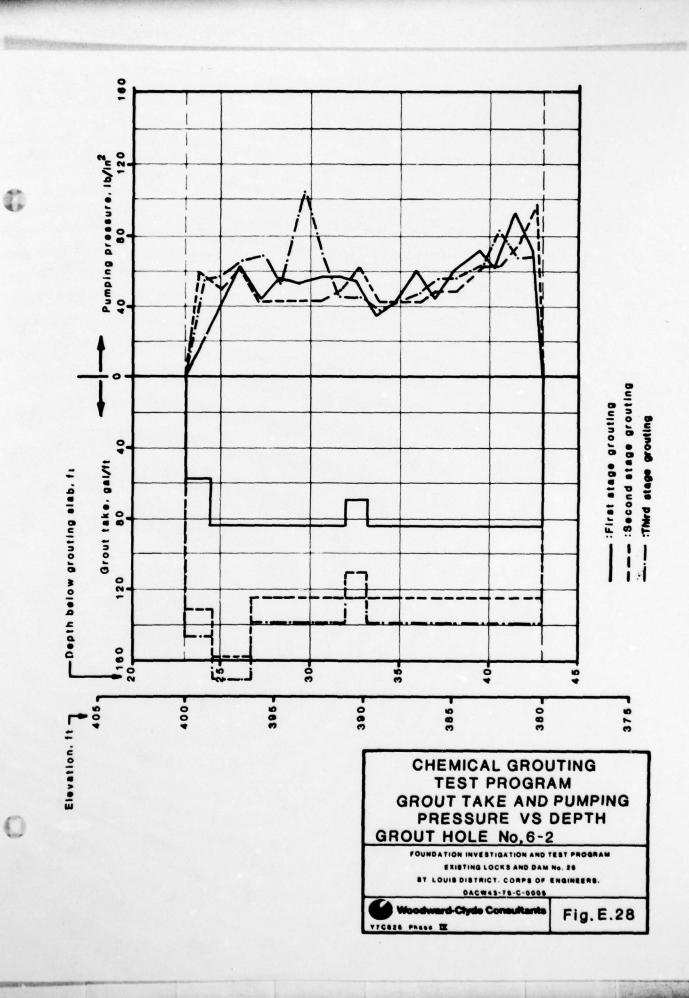




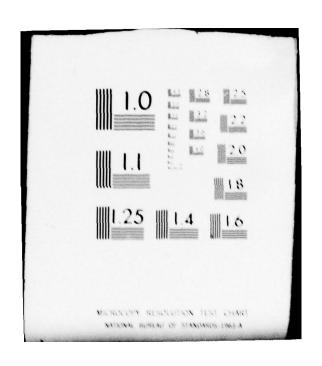


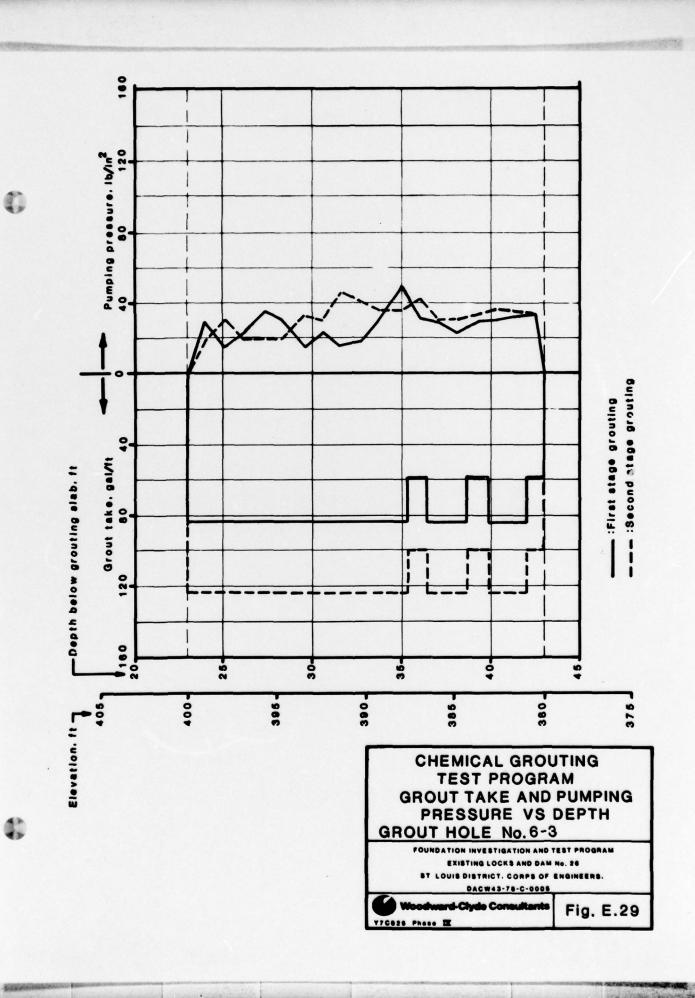


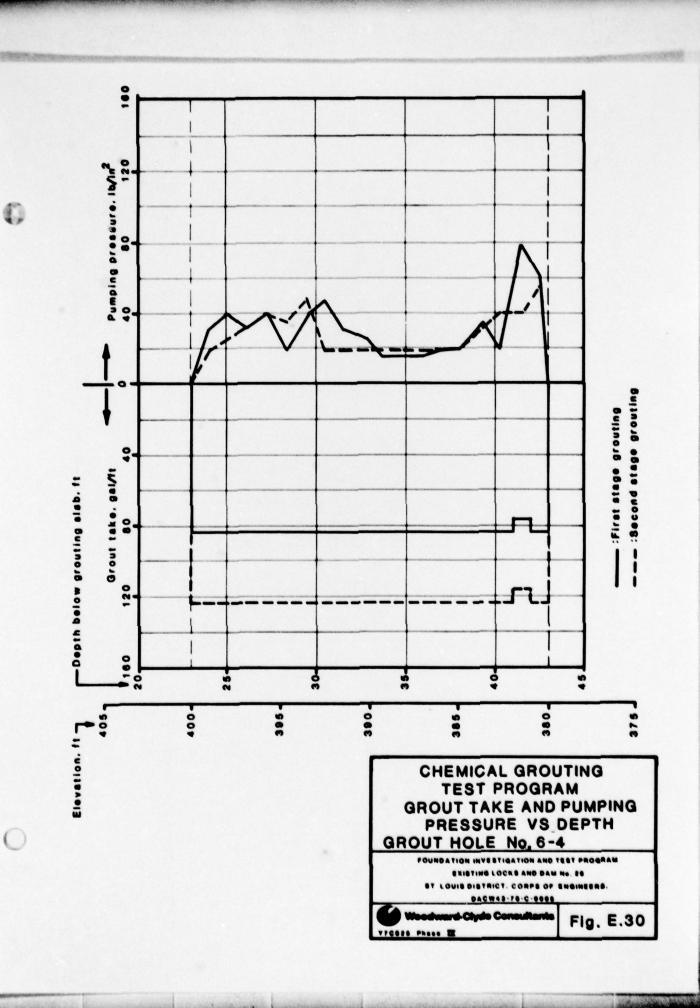


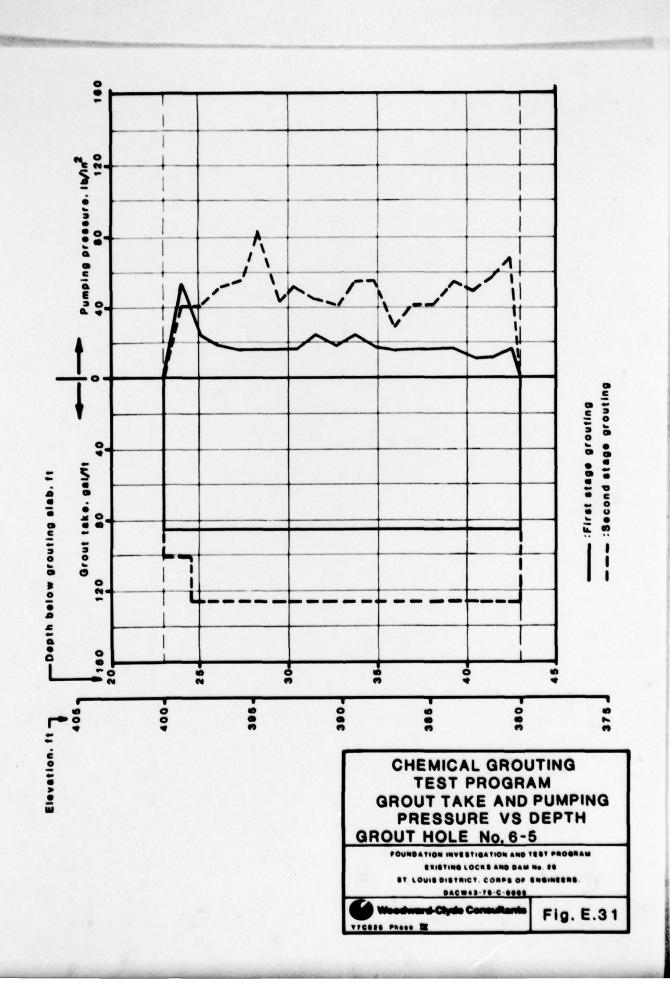


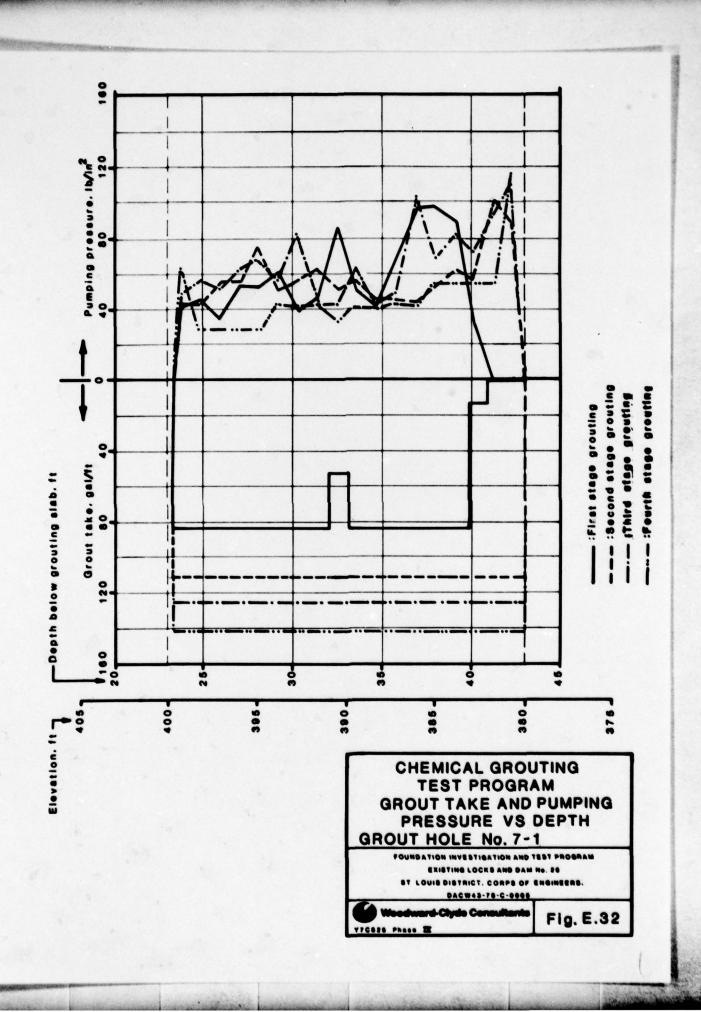
WOODWARD-CLYDE CONSULTANTS CHICAGO IL F/G 13/2 RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM. E--ETC(U) JUL 79 J PEREZ , Y LACROIX DACW43-78-C-0005 AD-A076 092 UNCLASSIFIED NL 2 of 3 AD A076092

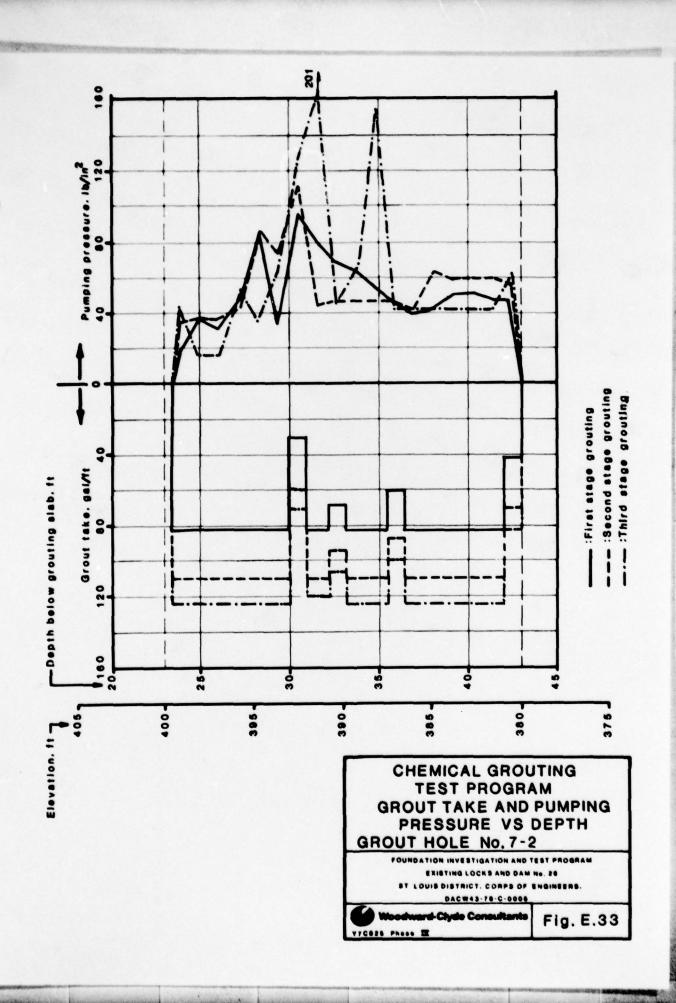


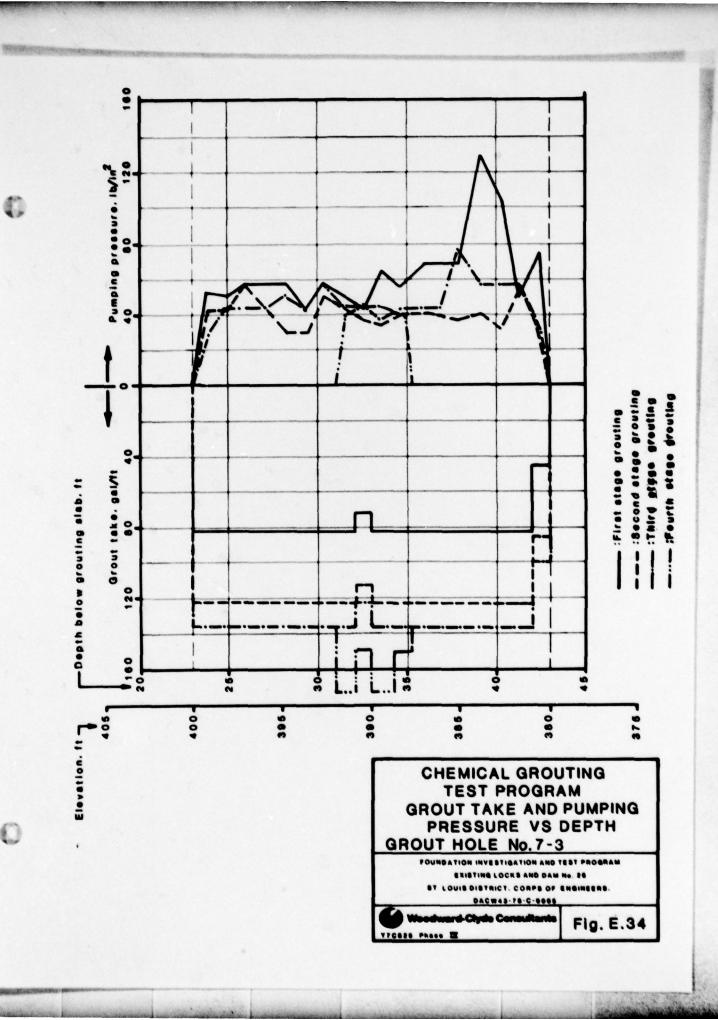


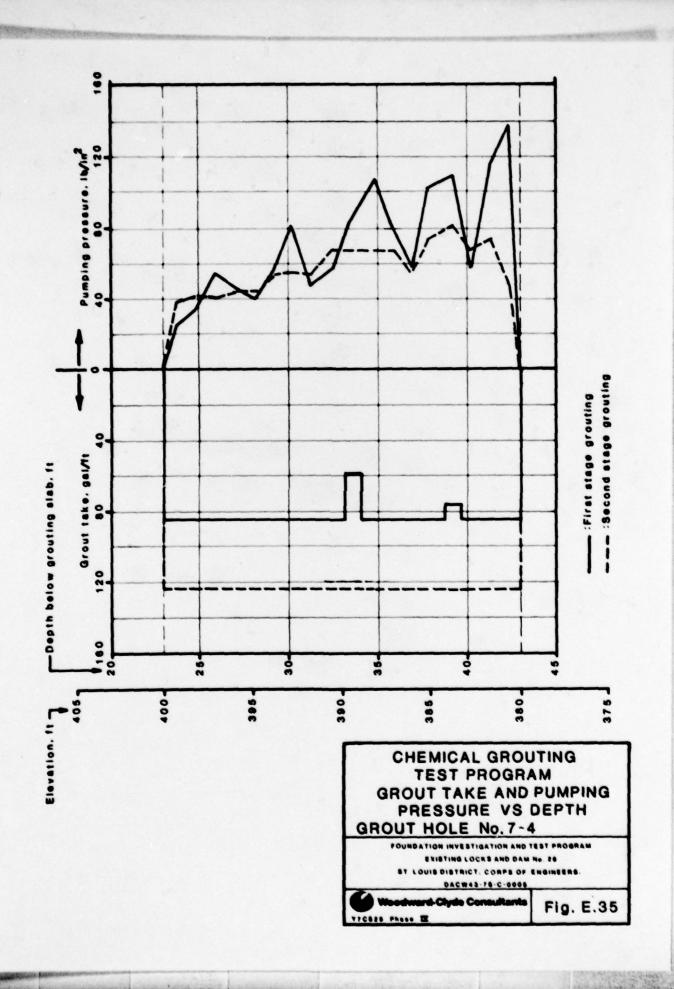


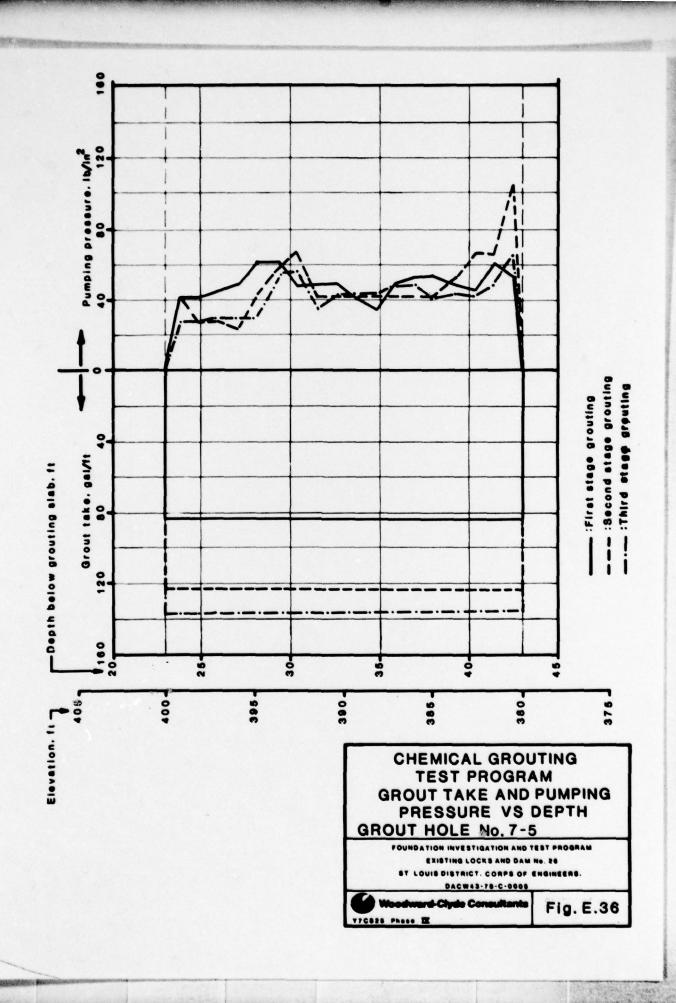


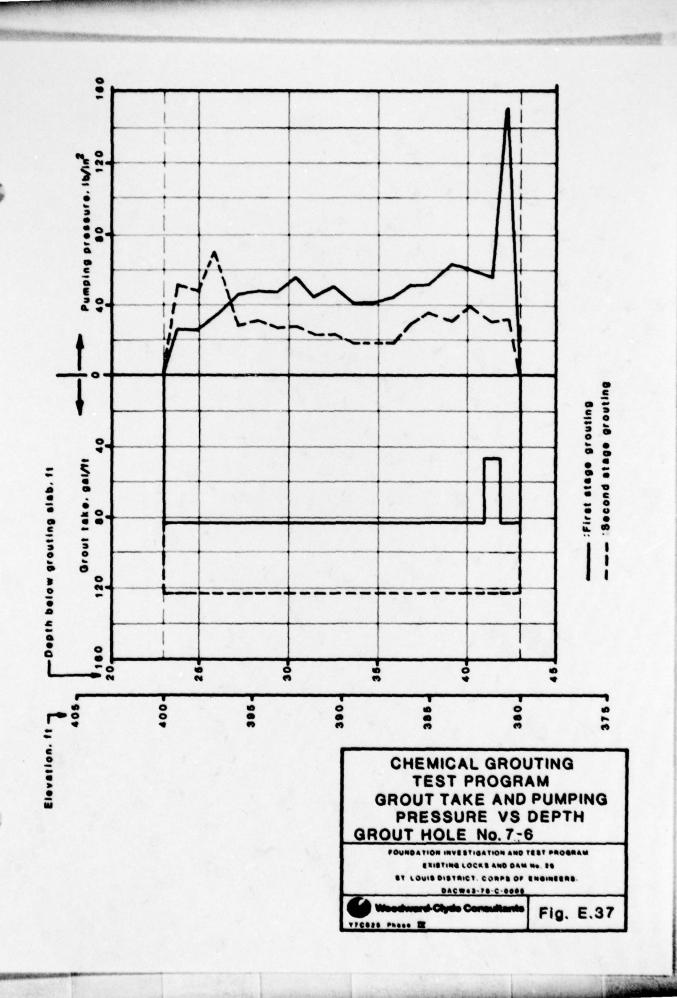


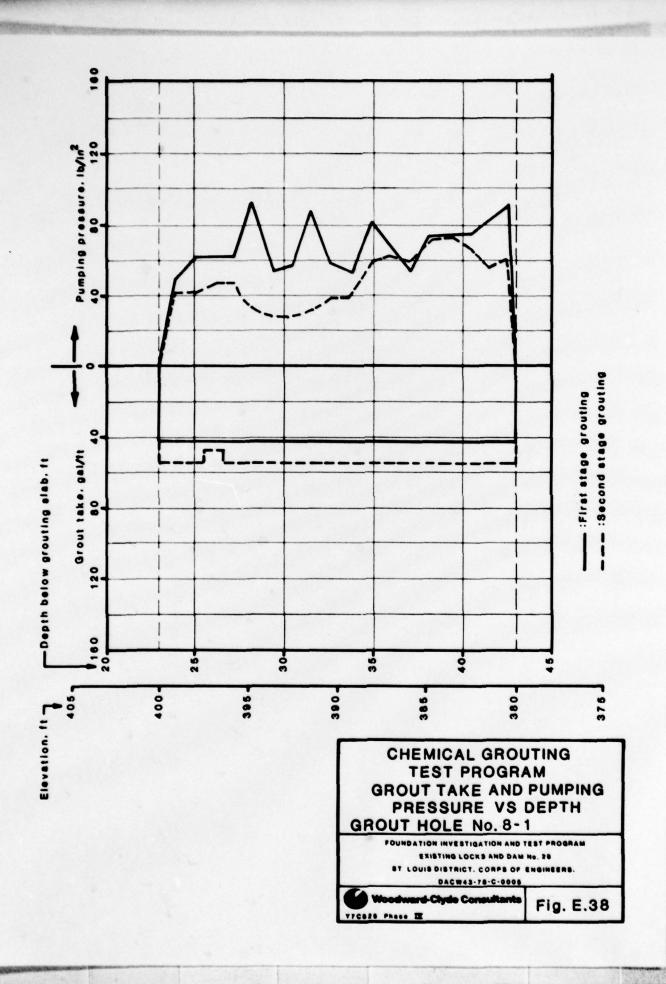


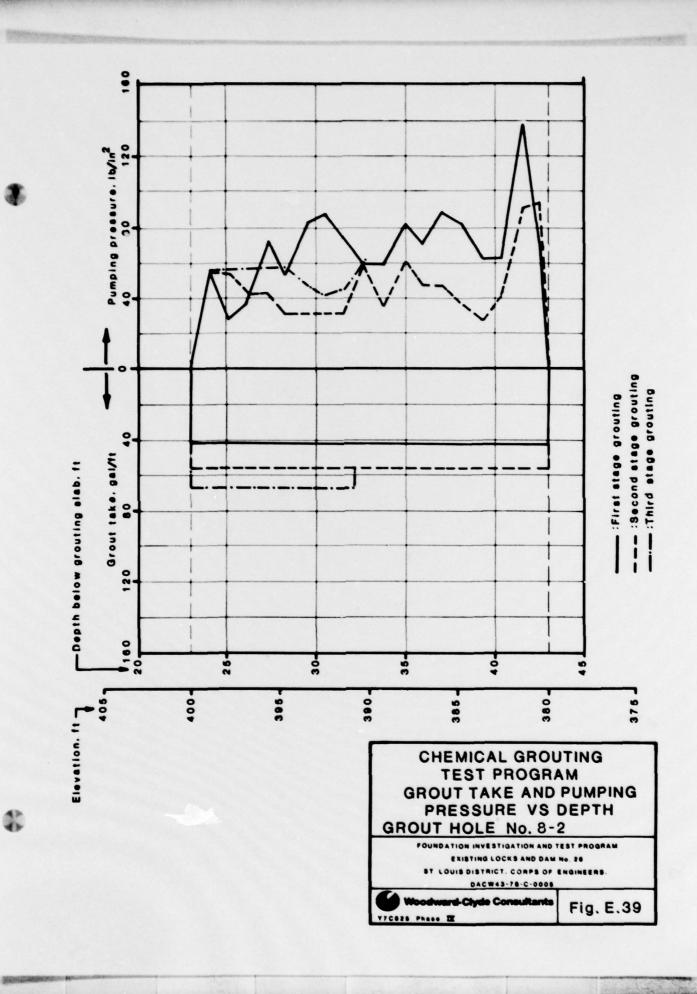


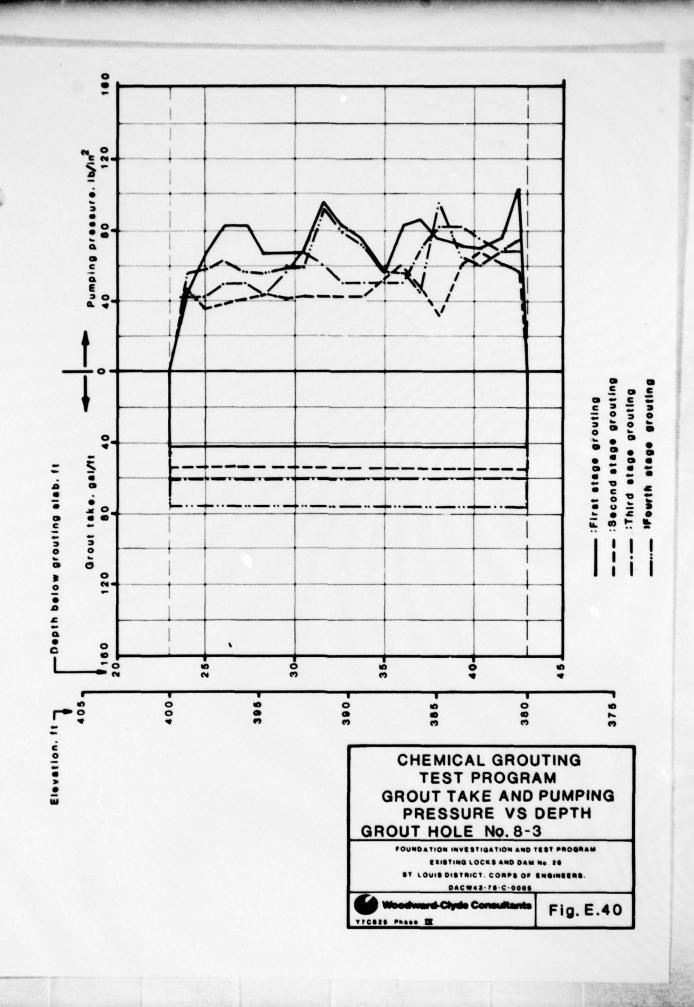


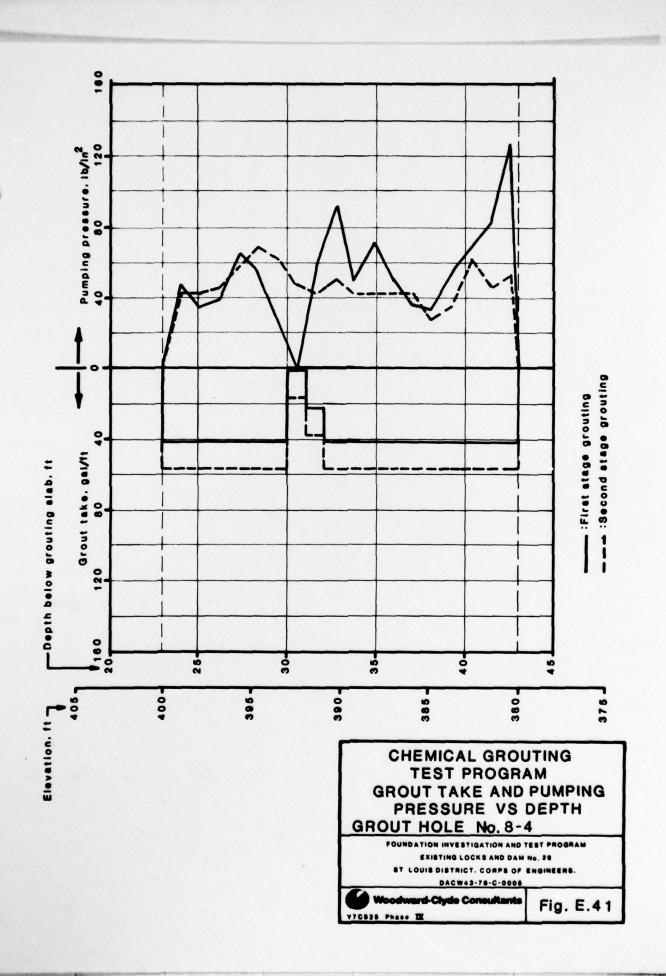


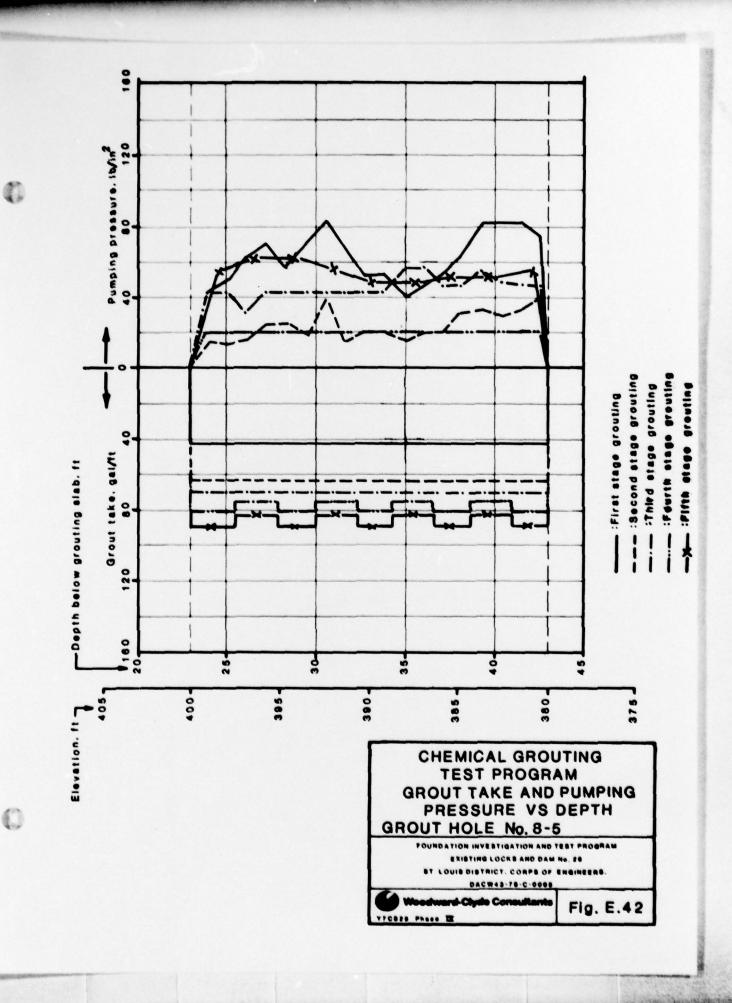


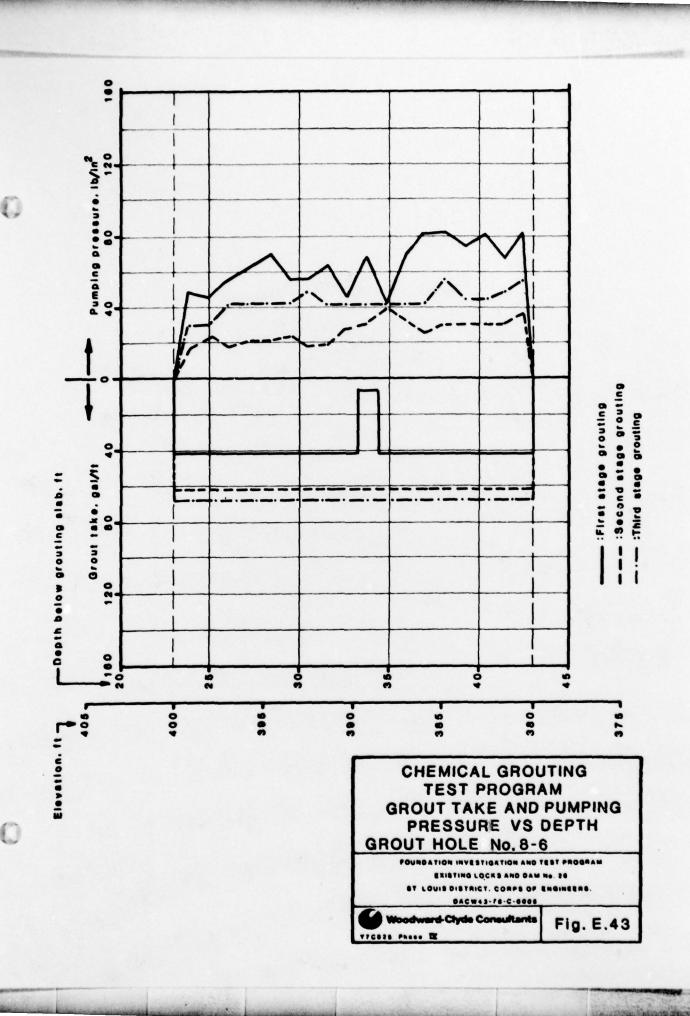


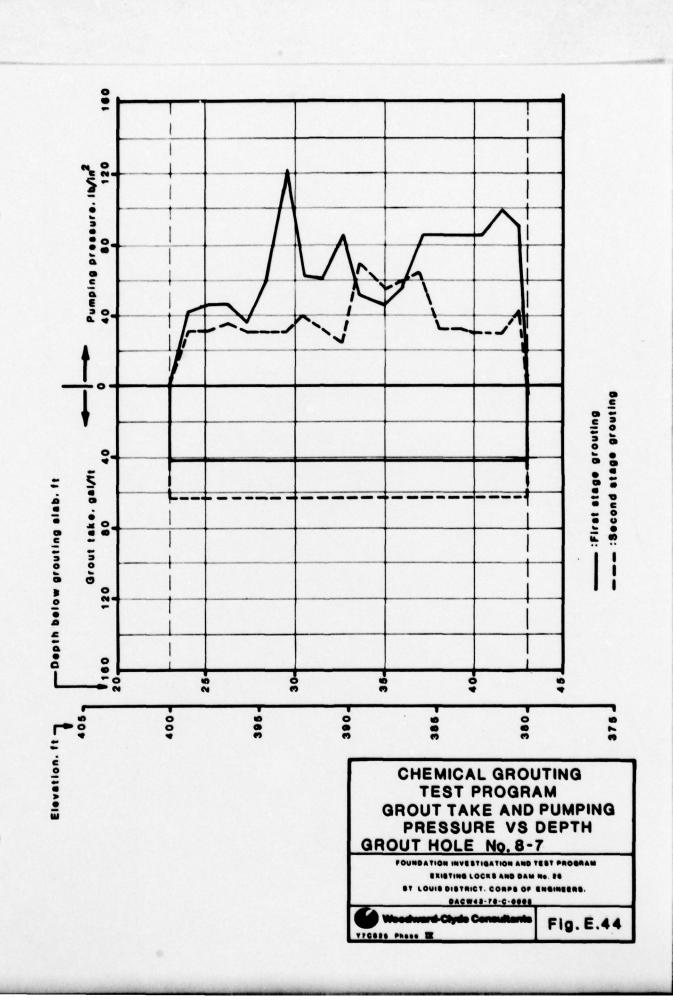


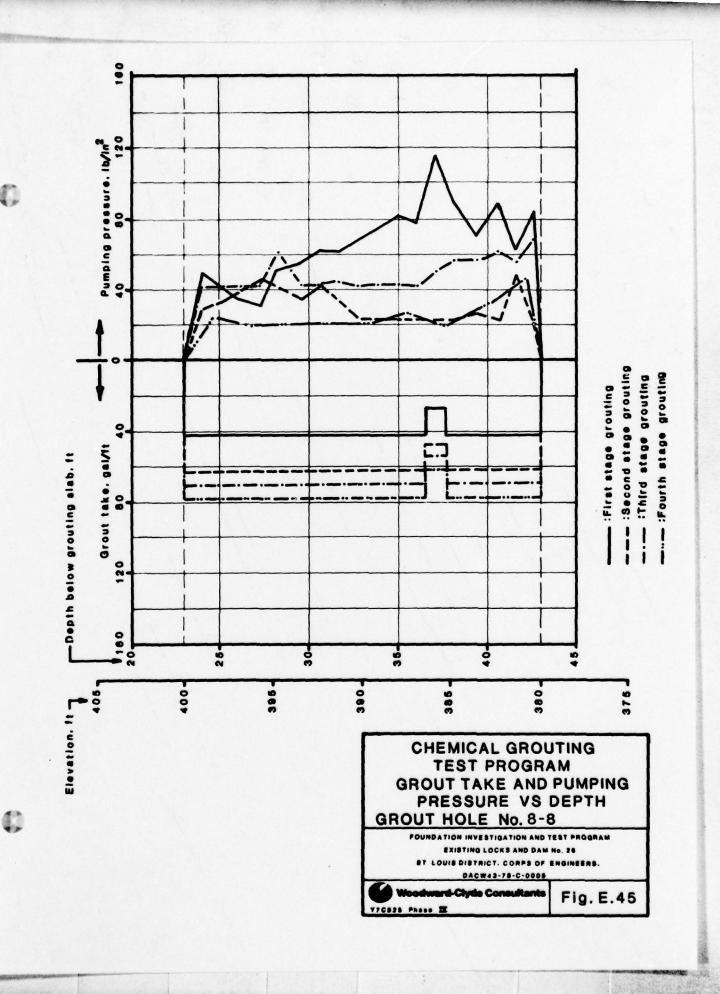


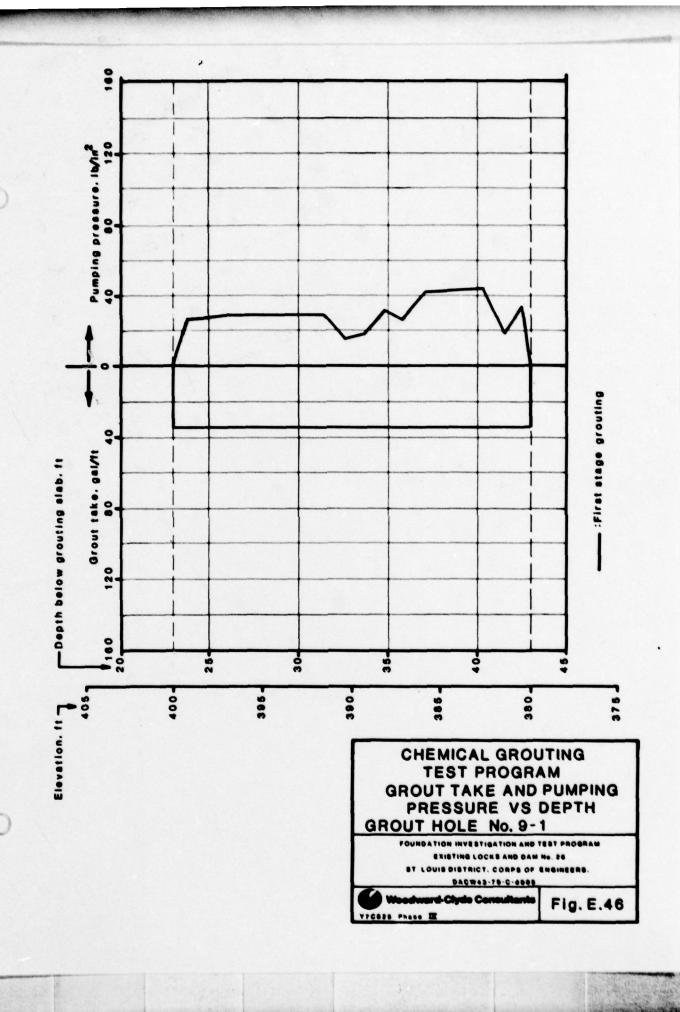


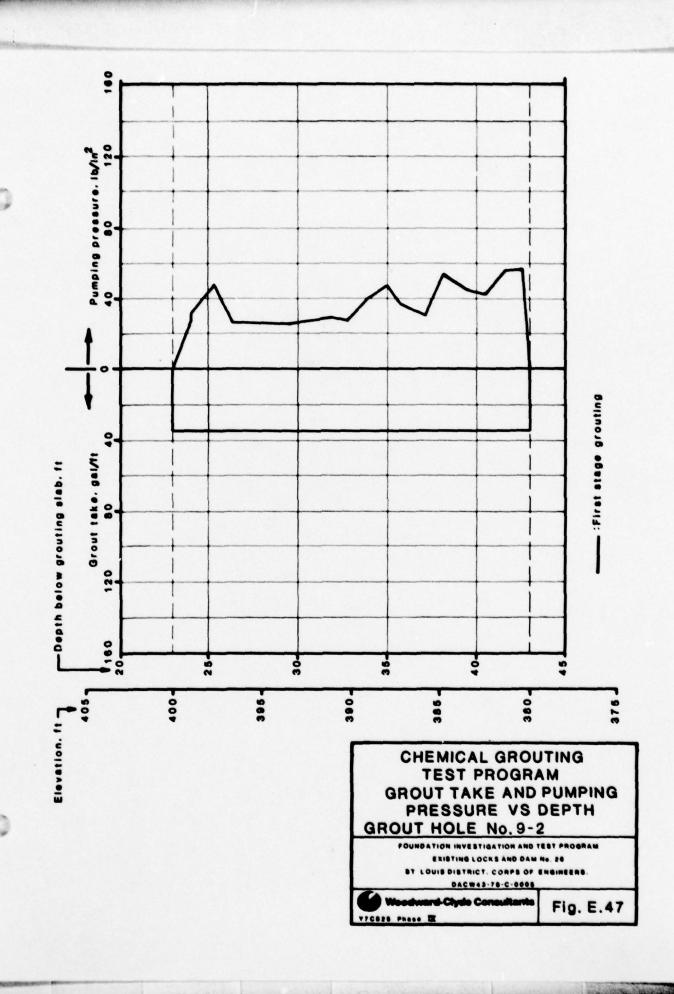


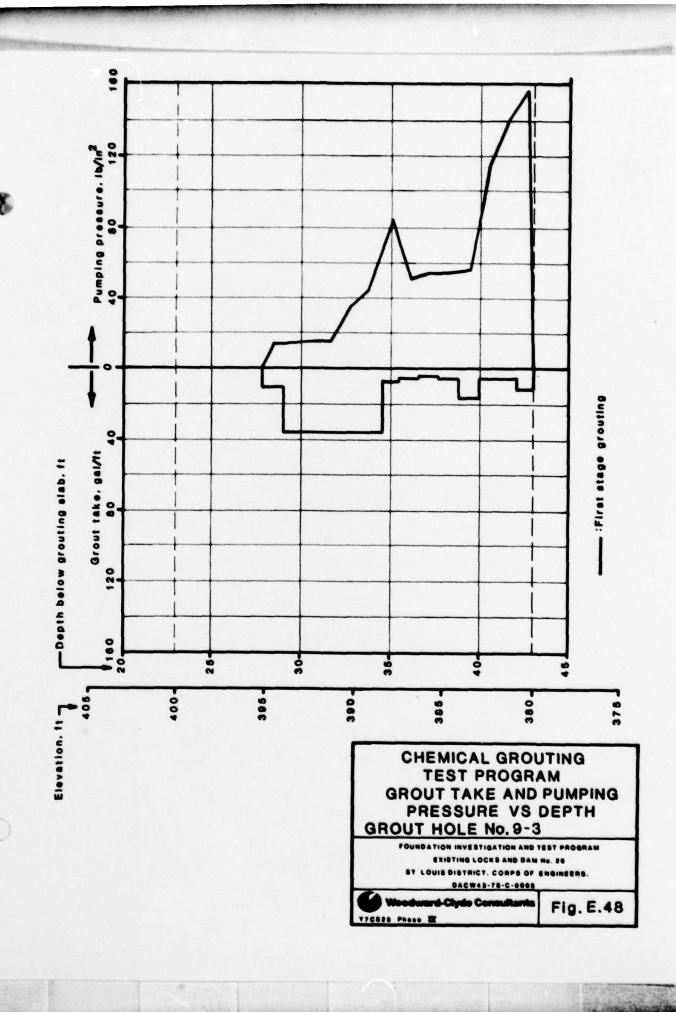


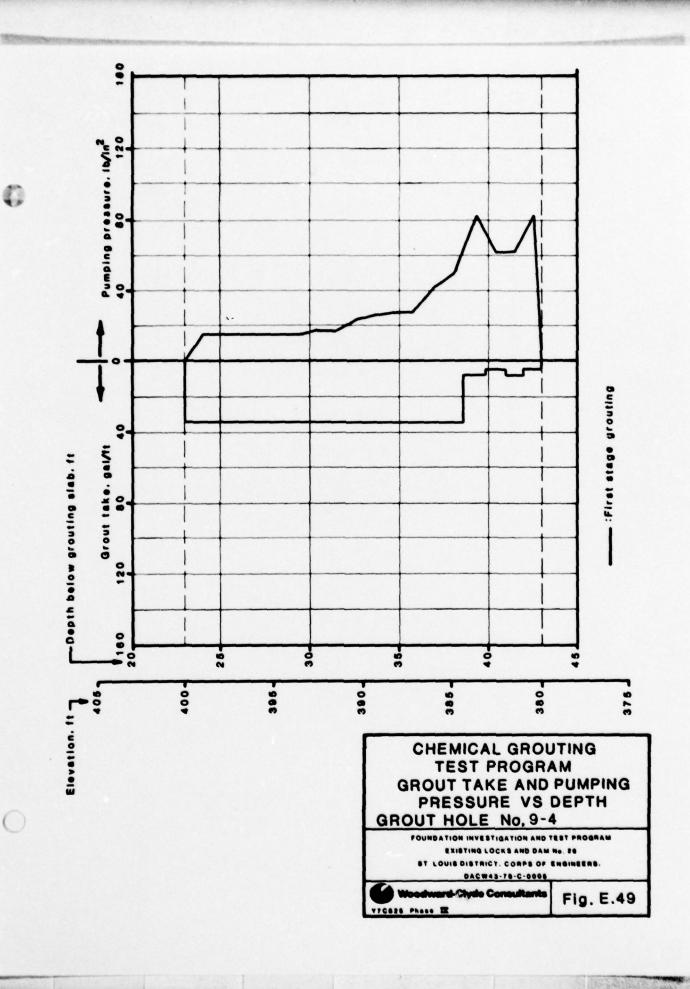


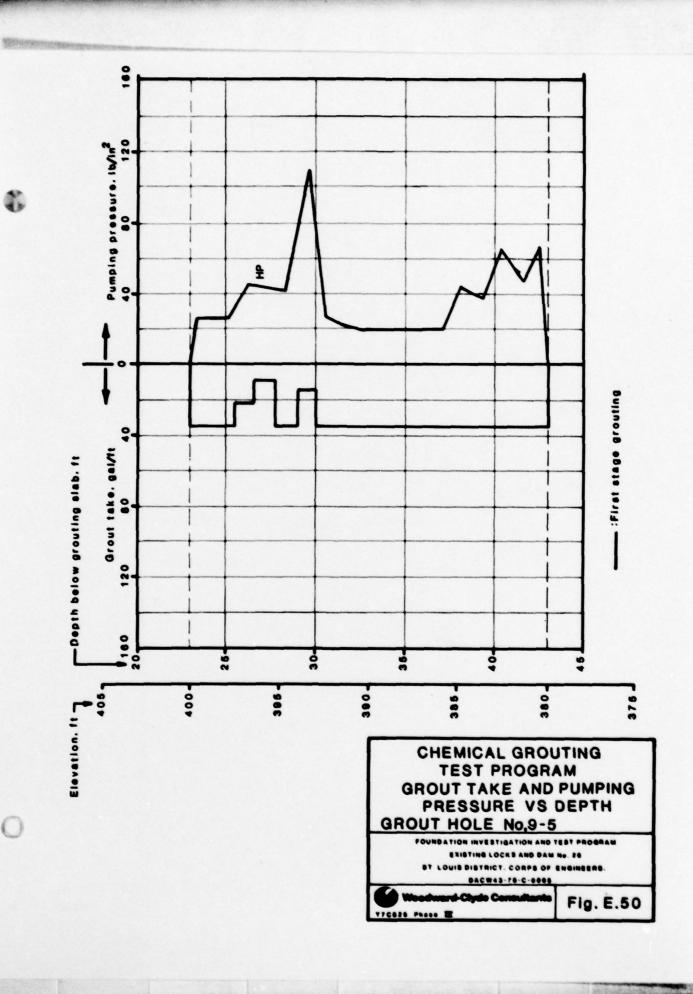


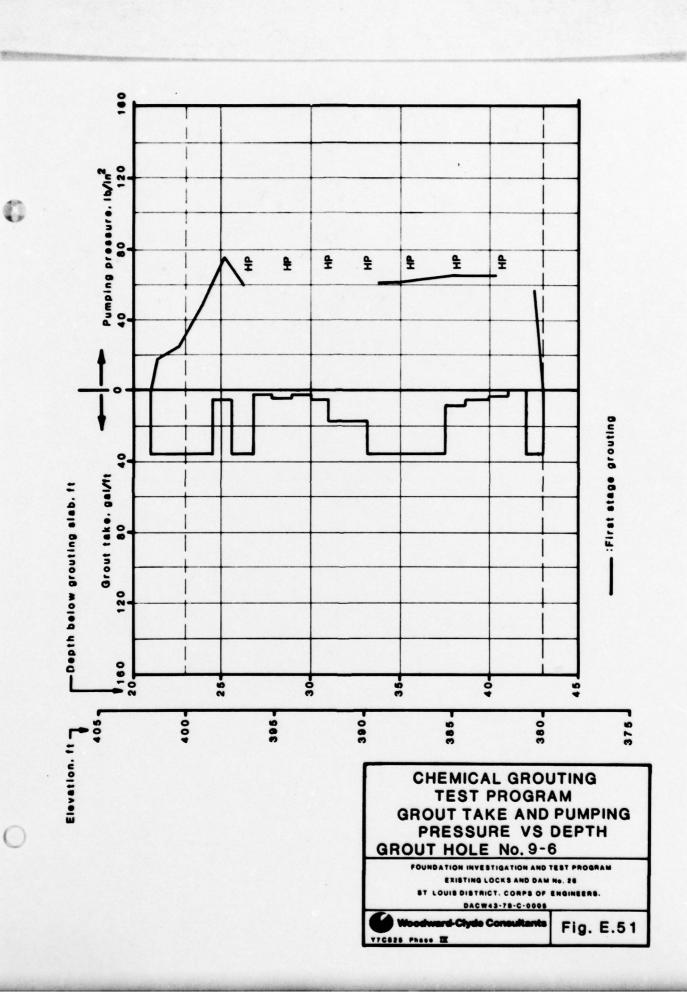


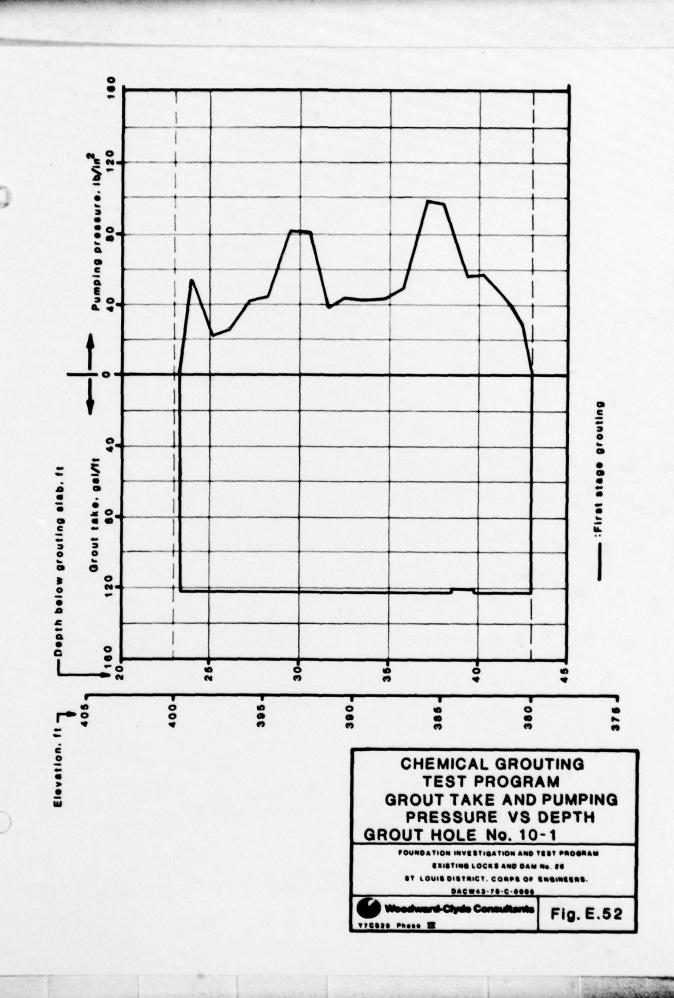


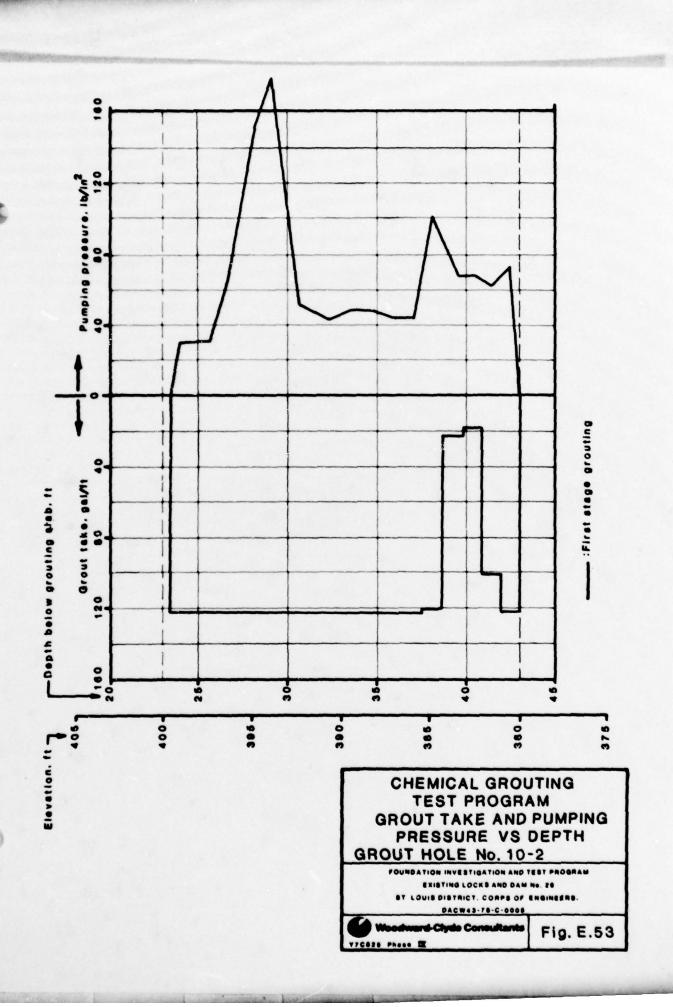


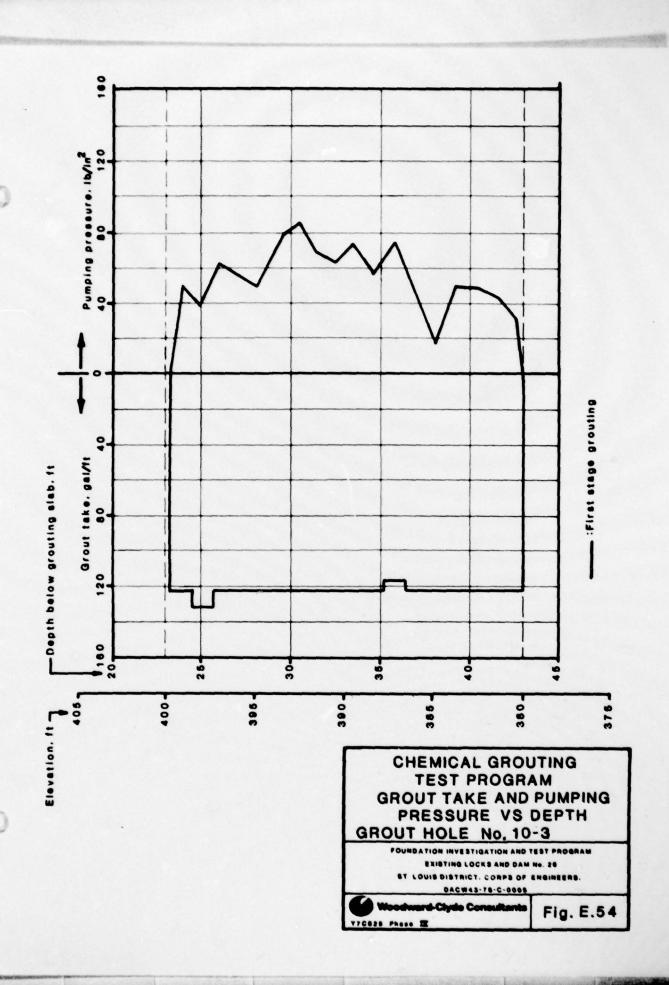


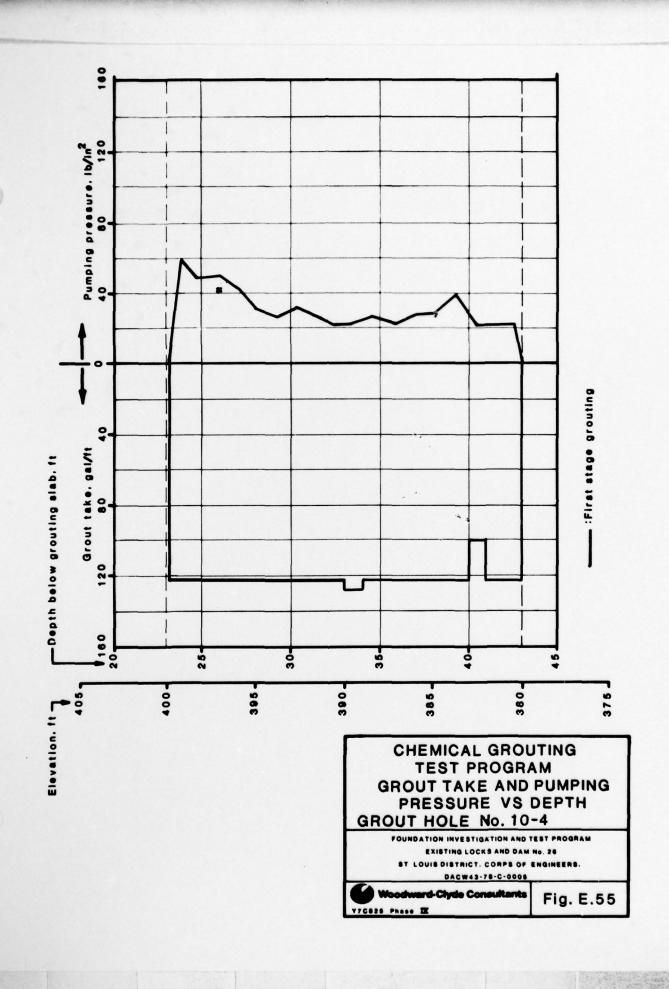


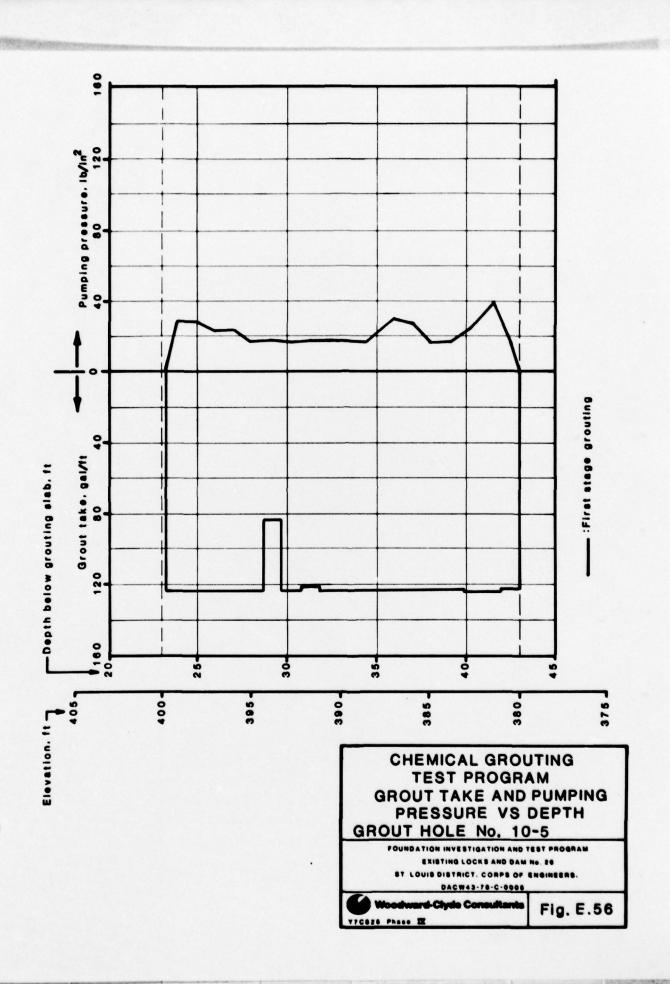


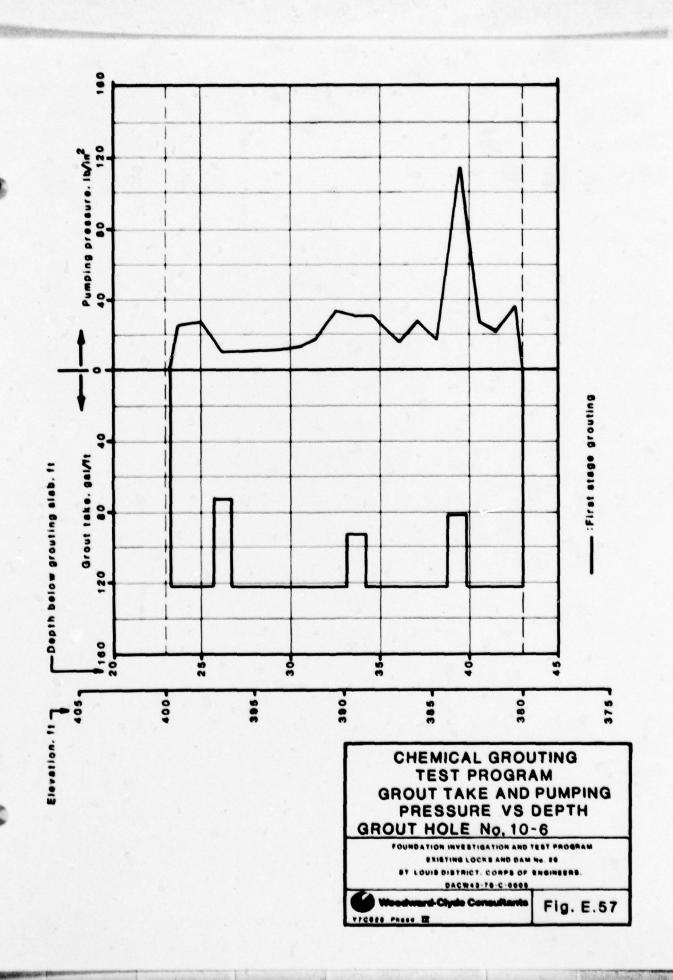


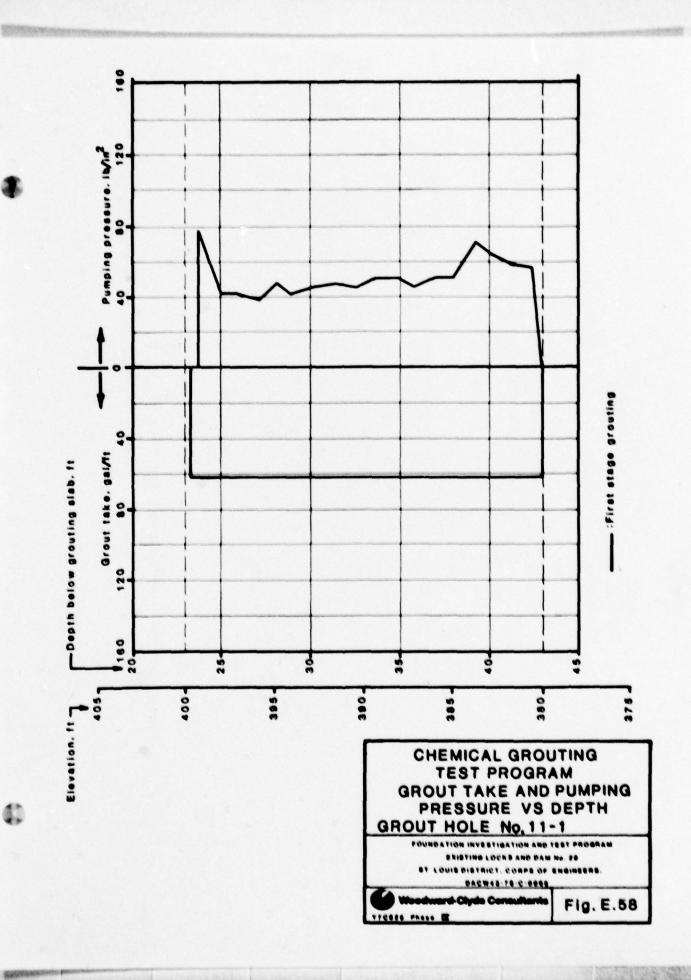


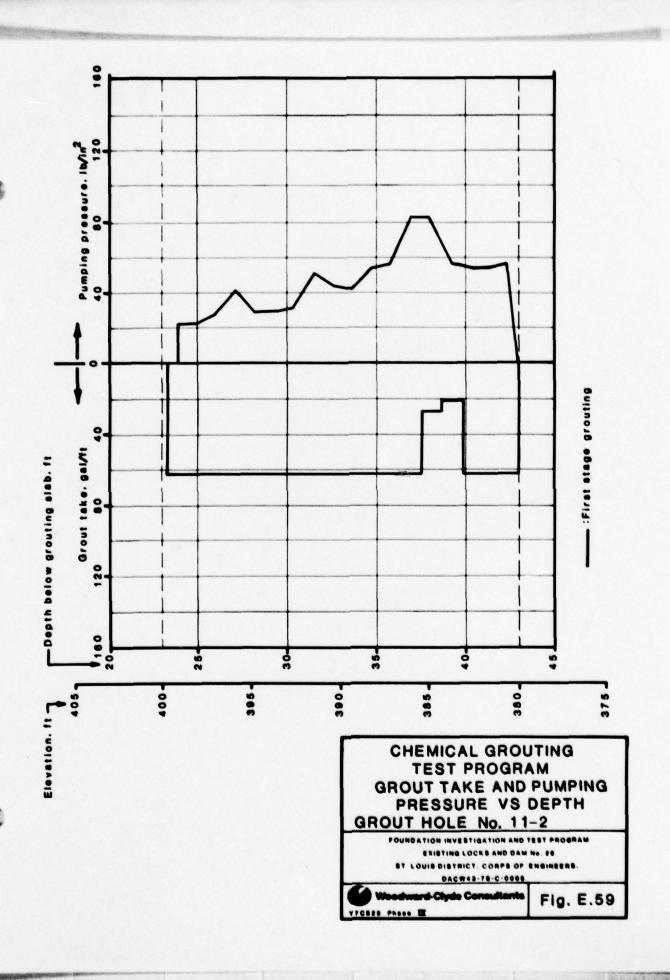


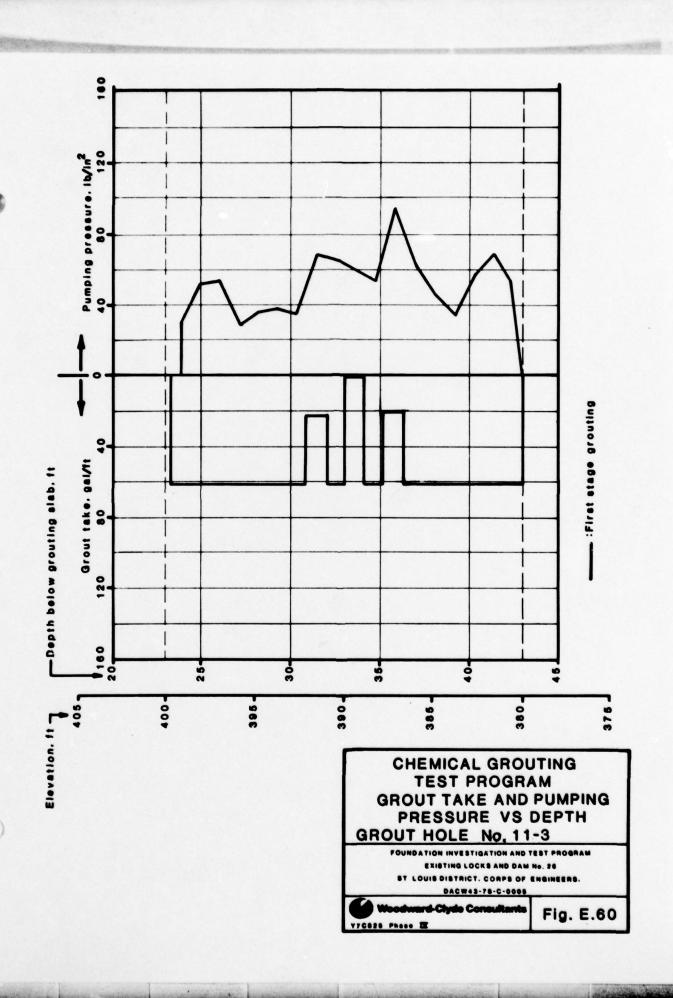


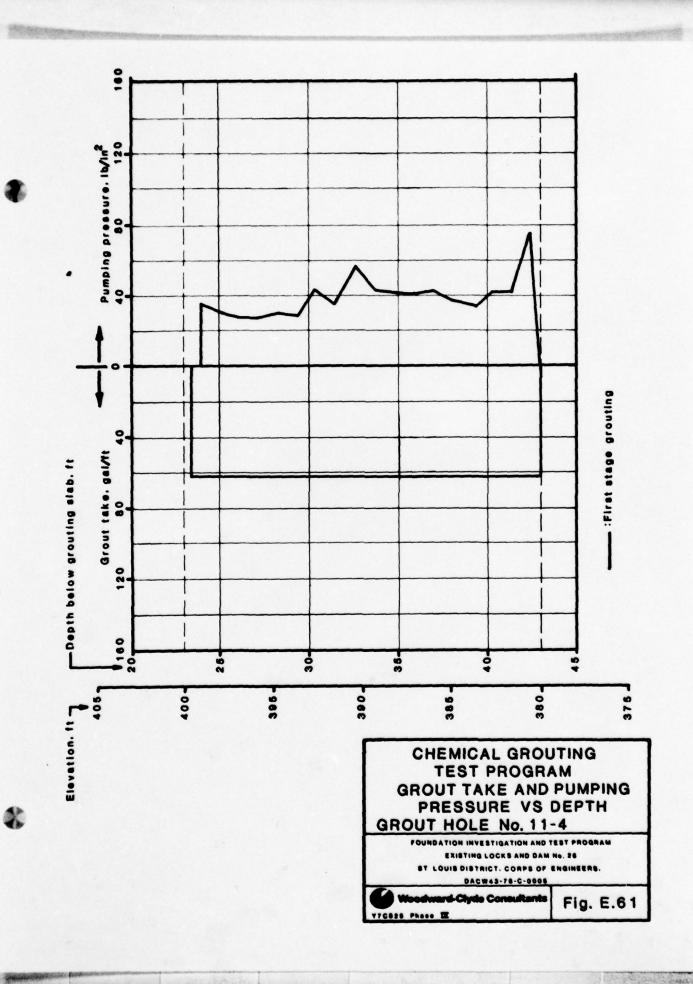


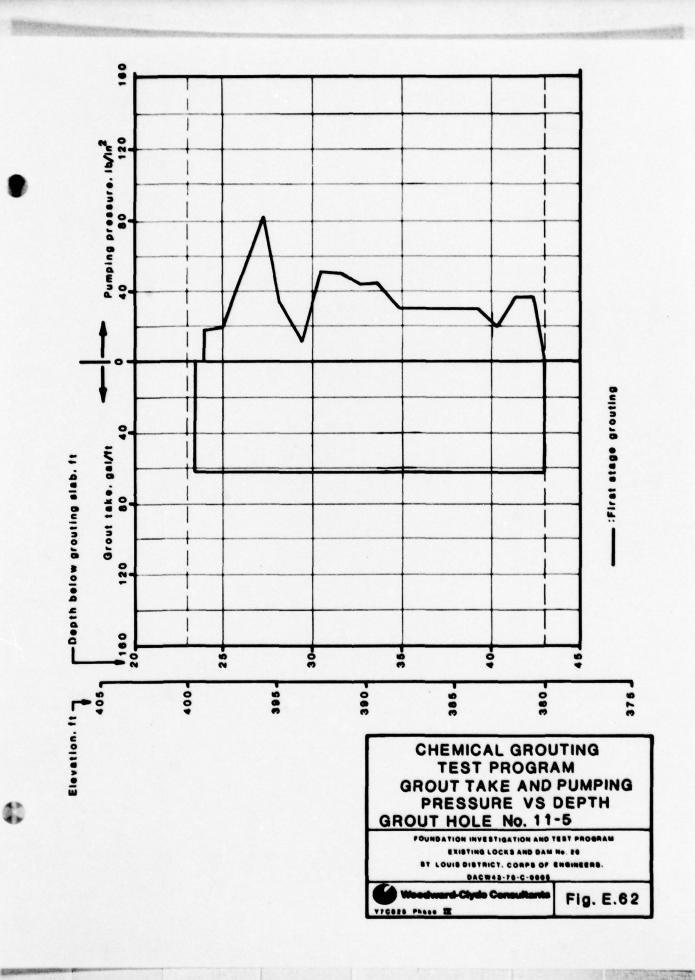


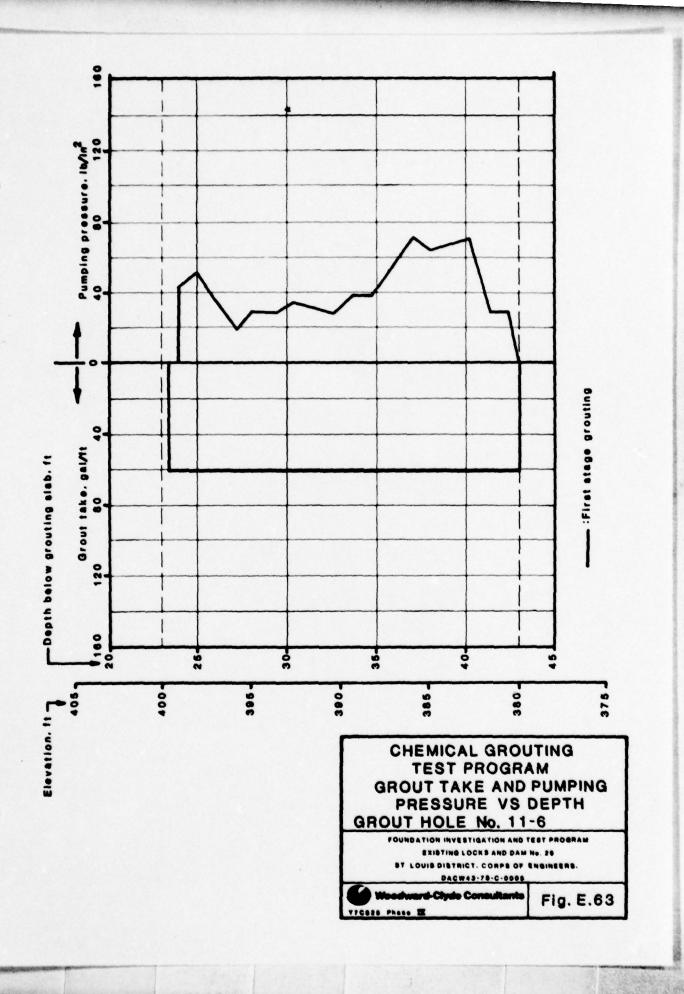


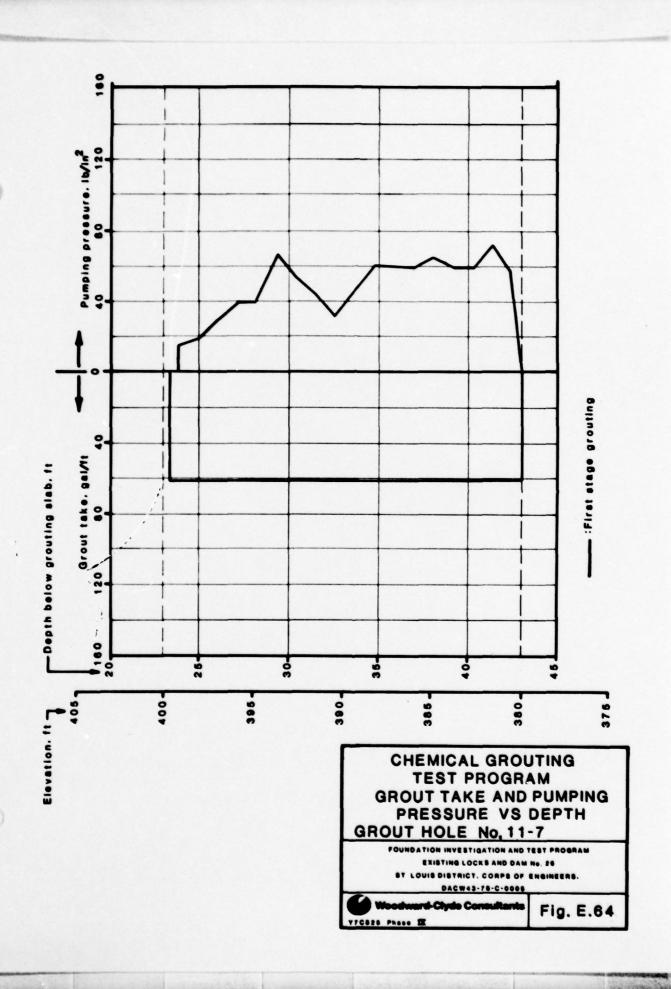


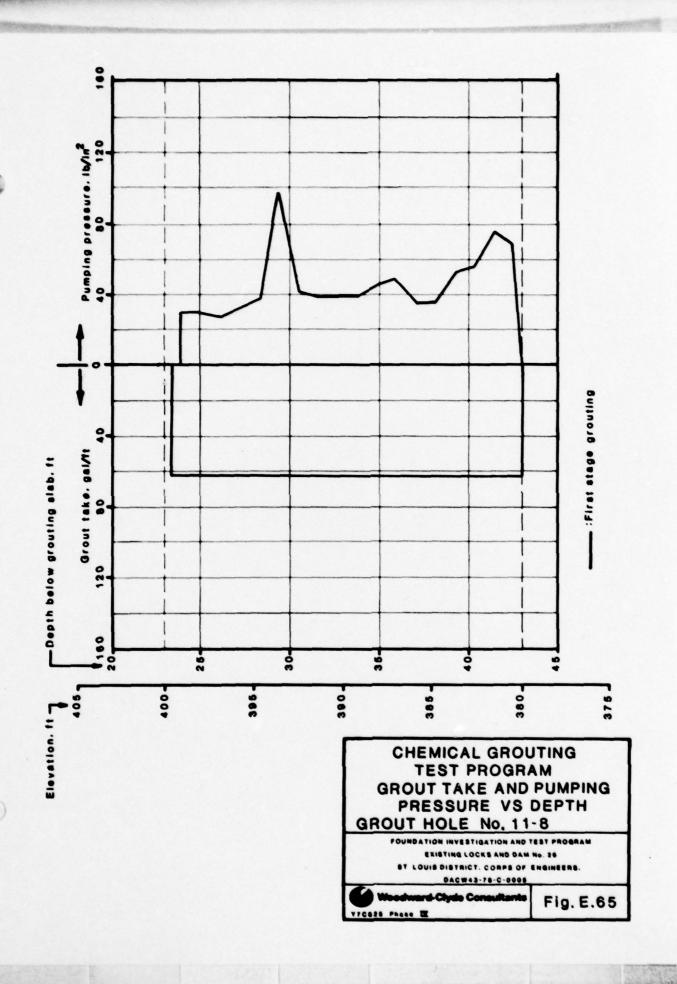


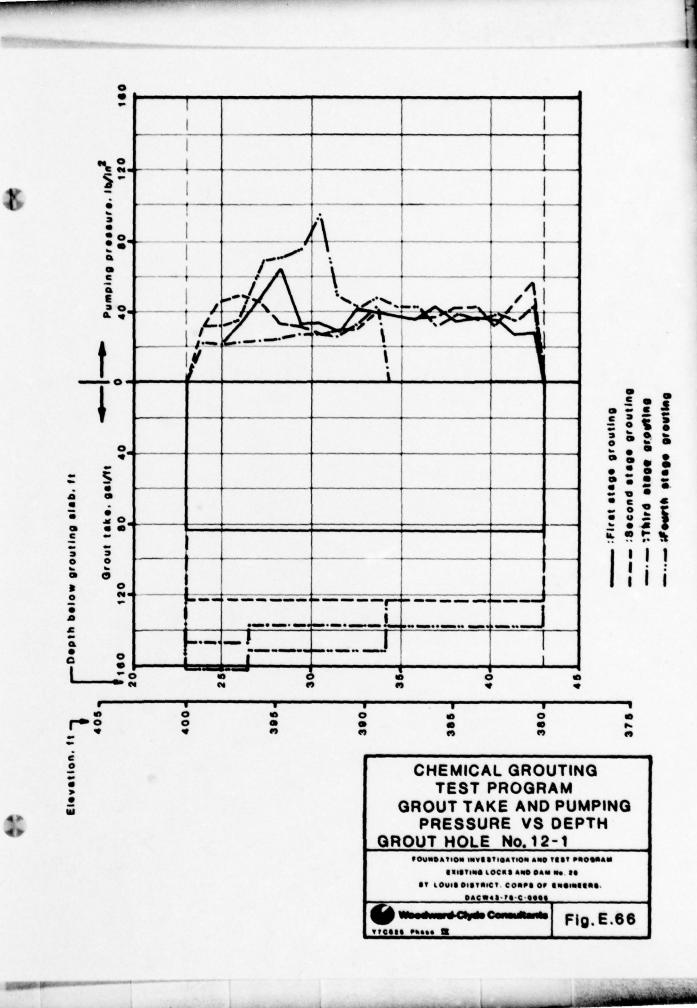


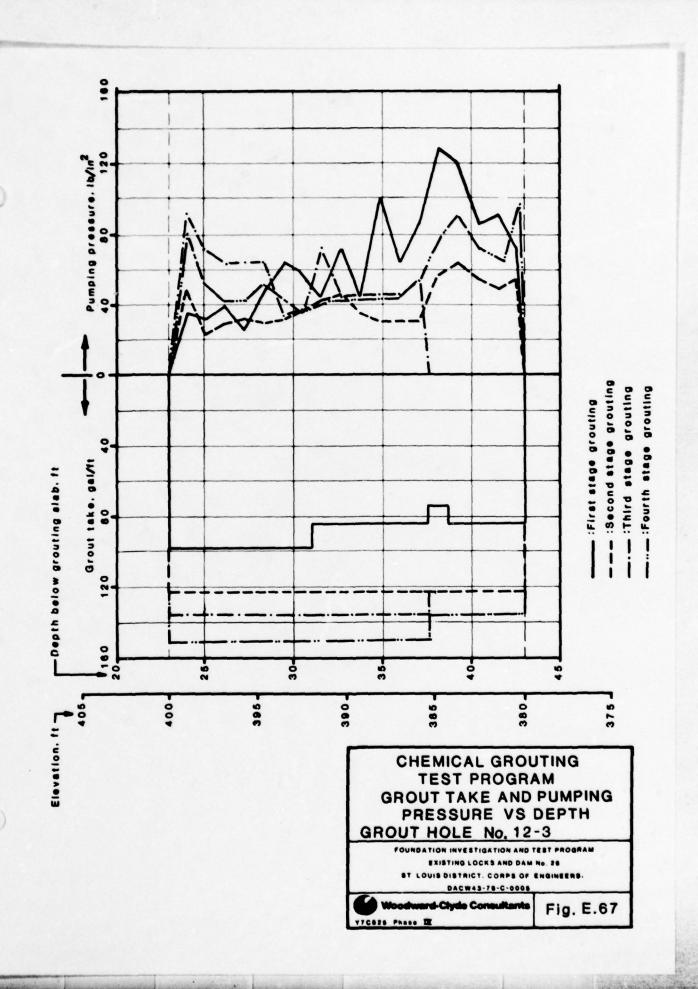


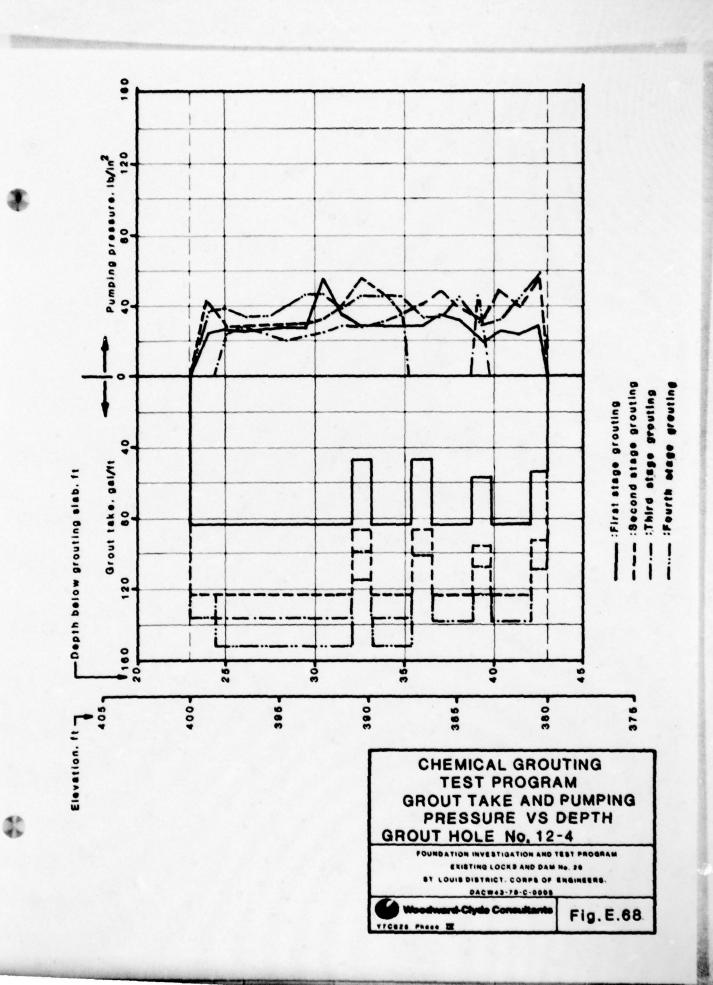


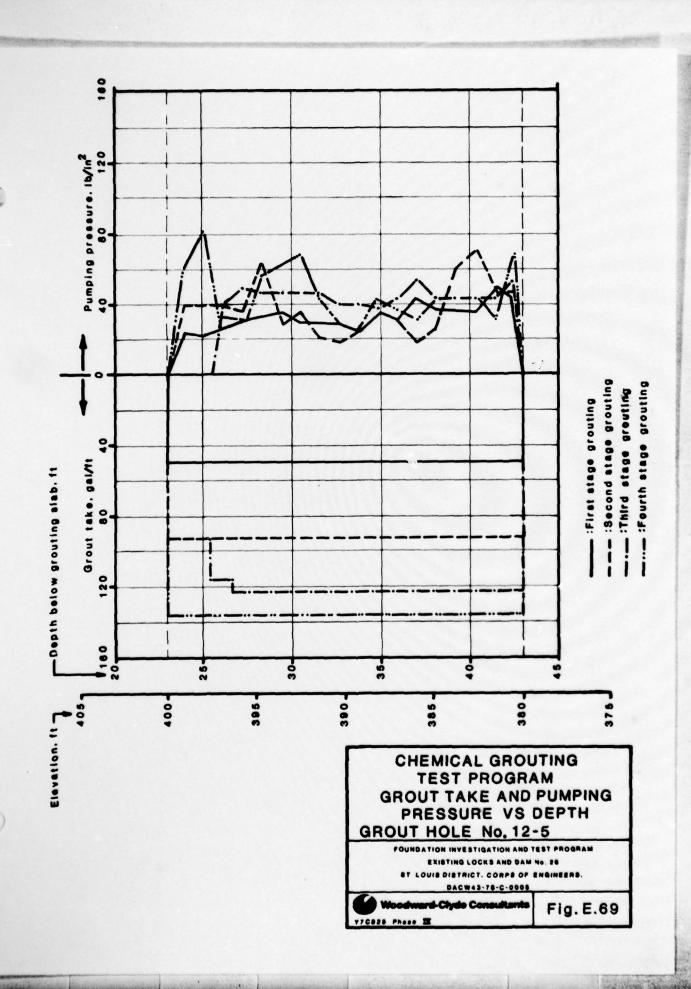


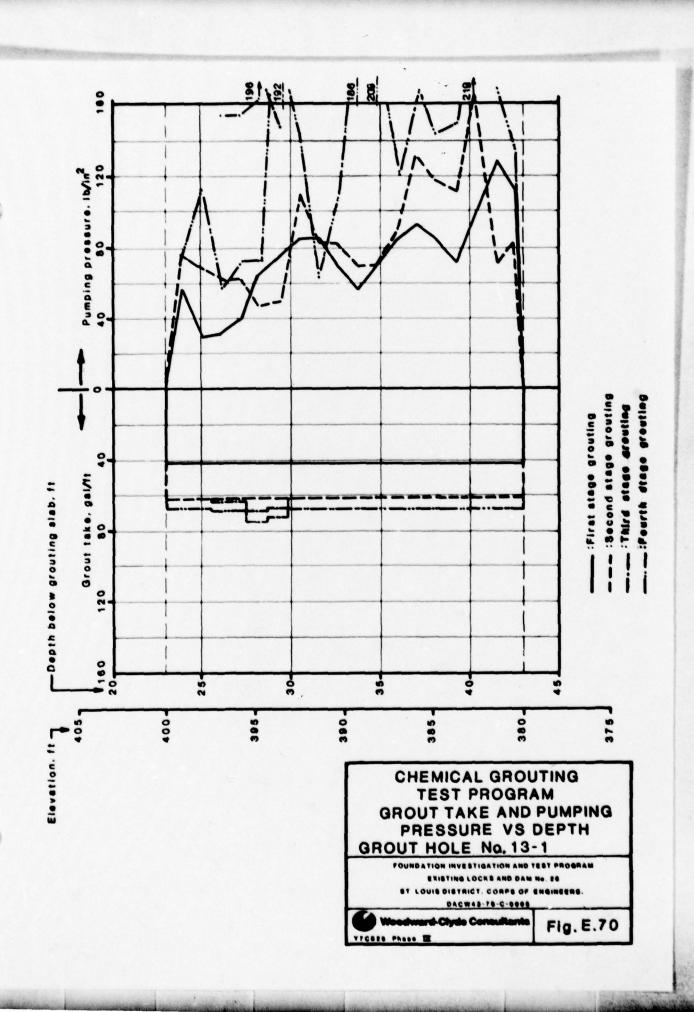


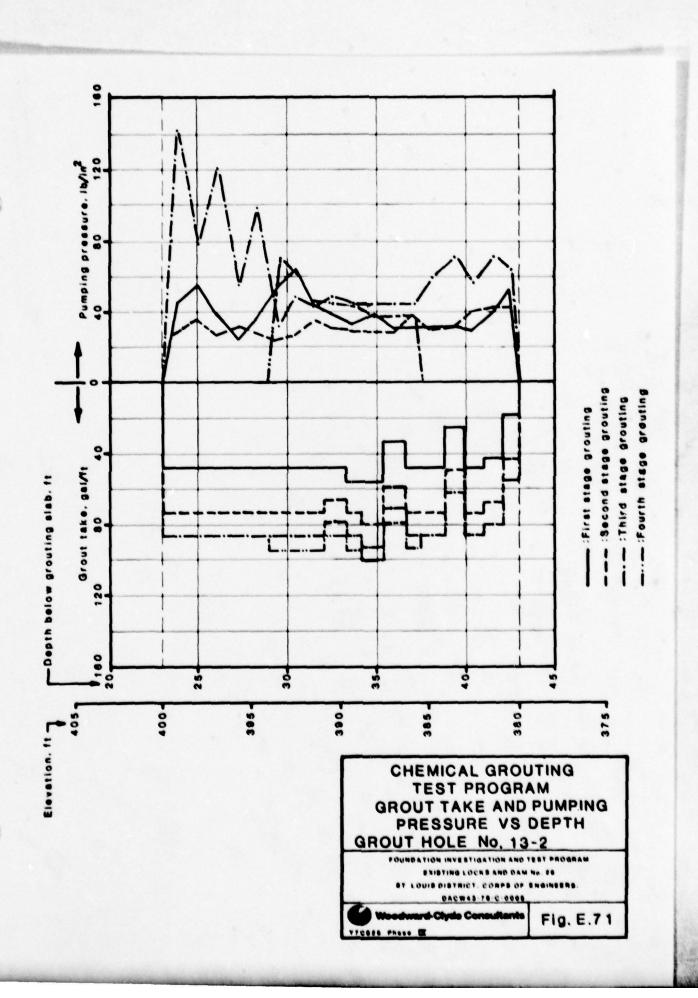


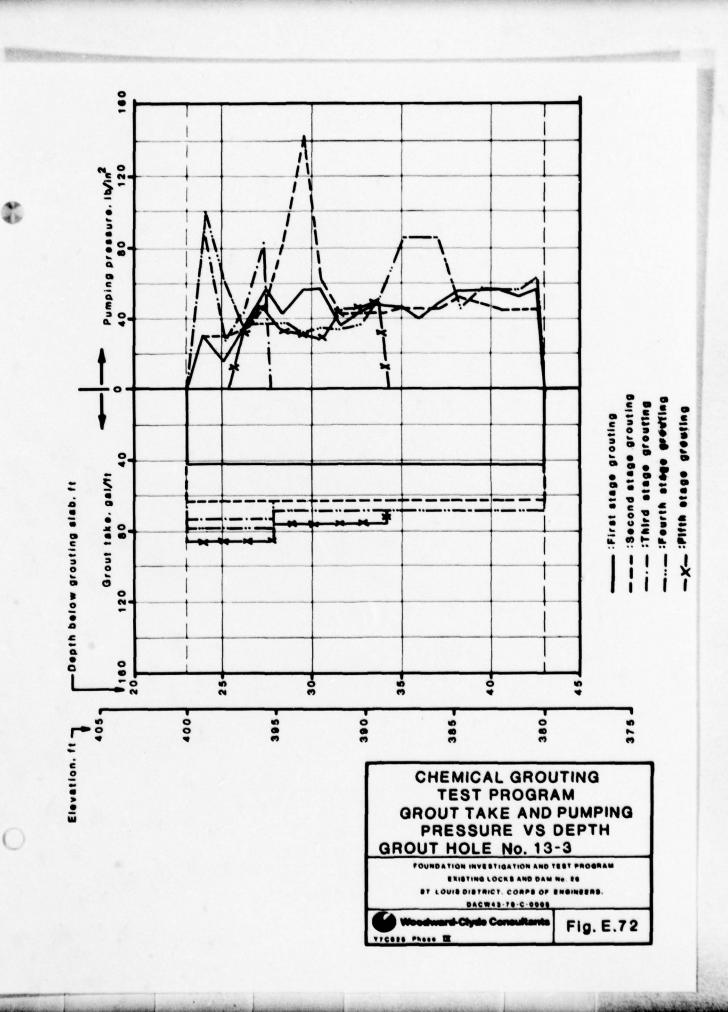


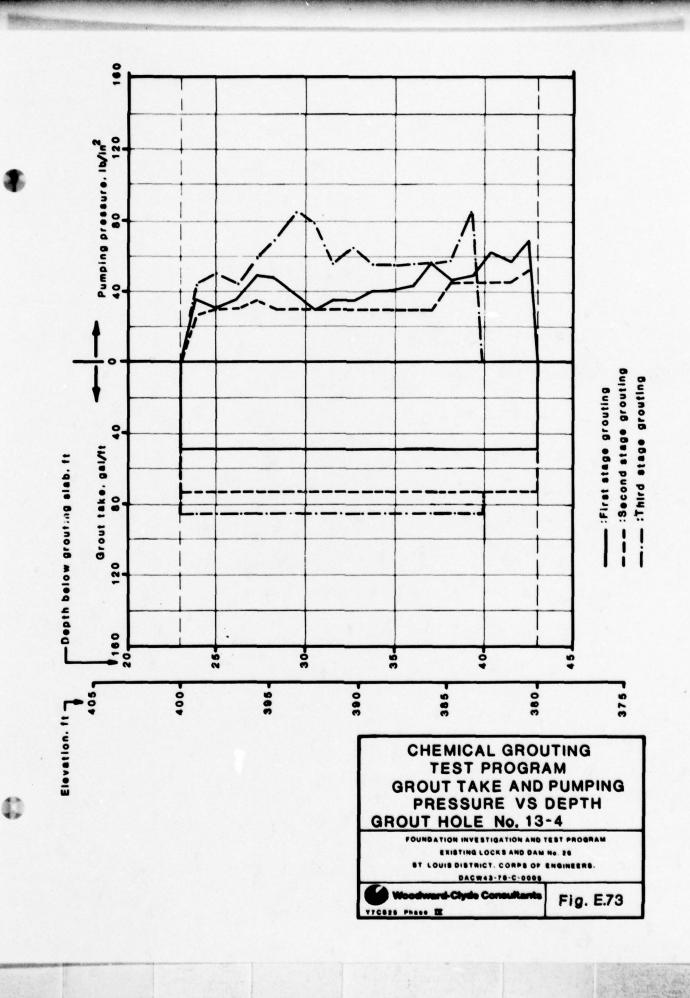


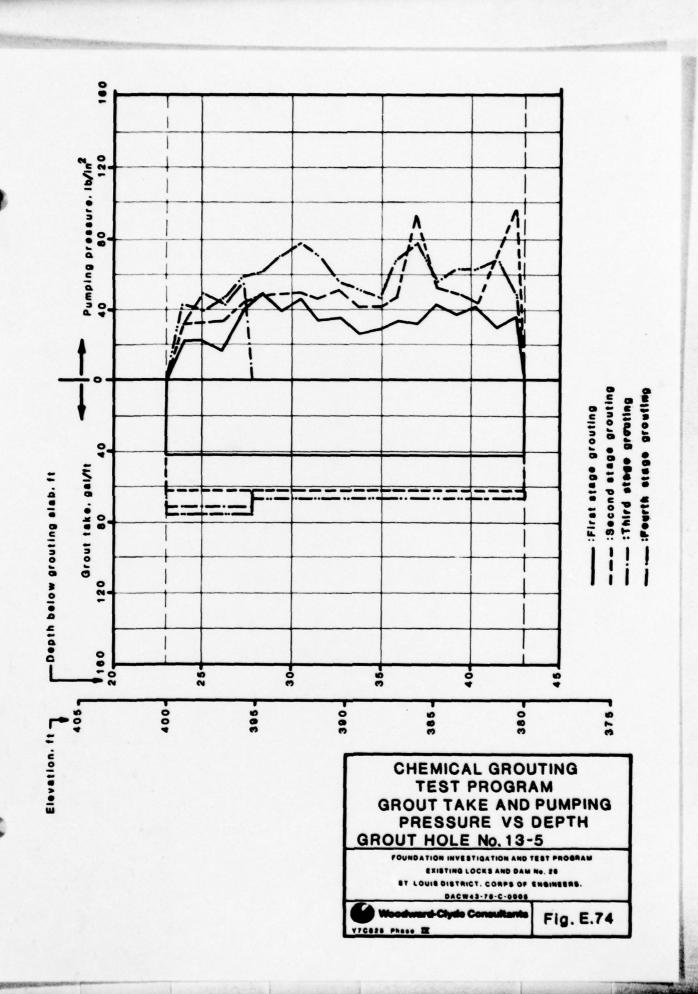












## PHASE IV REPORT VOLUME IIA

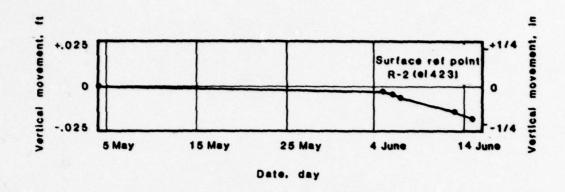
RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM

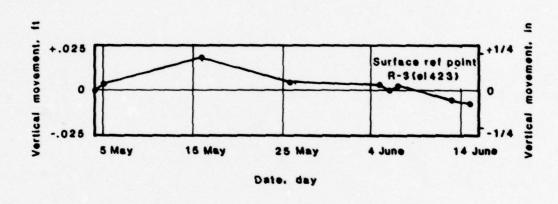
APPENDIX F
EFFECTS OF GROUTING

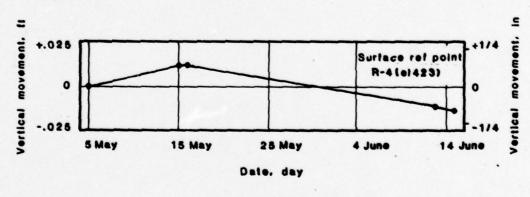
### APPENDIX F EFFECTS OF GROUTING

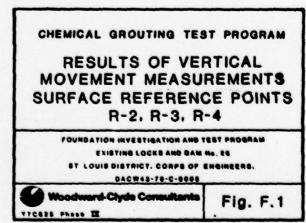
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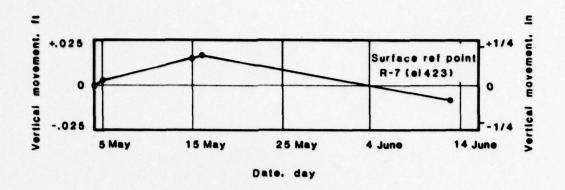
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Figure F.10 through Figure F.23	COMPARISON BETWEEN RESULTS OBTAINED WITH BORROS GAGES AND SURFACE REFERENCE POINTS
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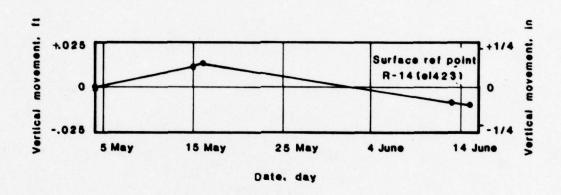


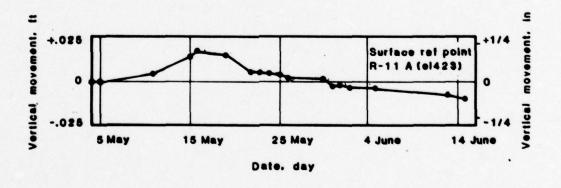






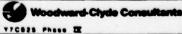


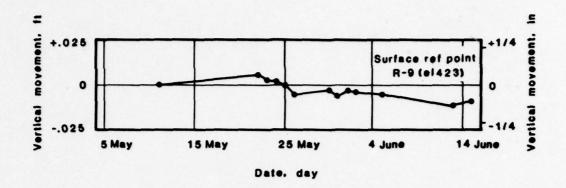


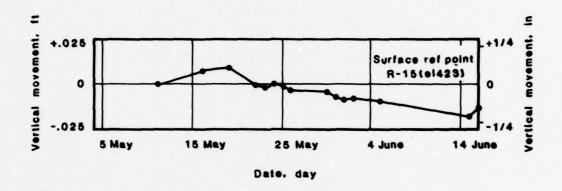


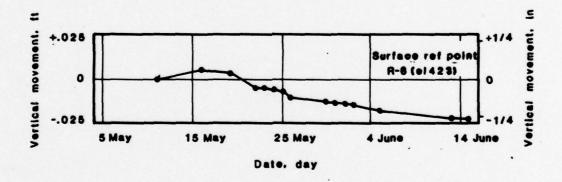
# RESULTS OF VERTICAL MOVEMENT MEASUREMENTS SURFACE REFERENCE POINTS R-7, R-14, R-11A FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND SAM No. 26

EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.
DACW43-79-C-6665



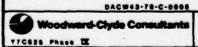


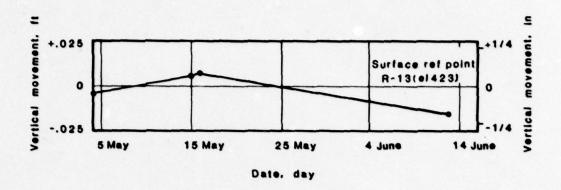


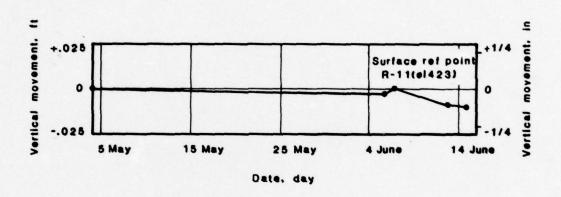


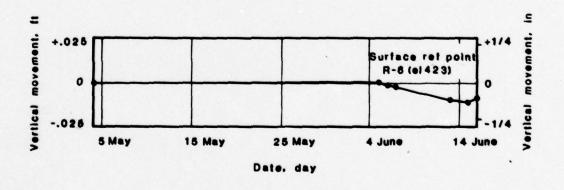
RESULTS OF VERTICAL MOVEMENT MEASUREMENTS SURFACE REFERENCE POINTS R-9, R-15, R-8

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT, CORPS OF ENGINEERS.



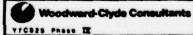


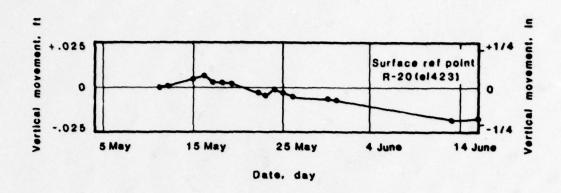


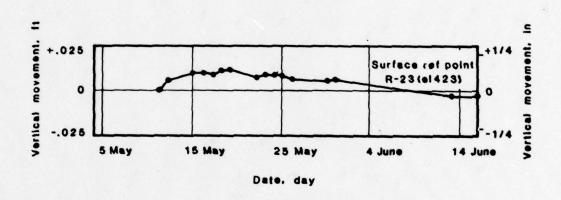


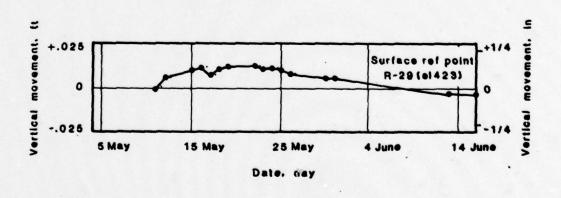
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FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT, CORPS OF ENGINEERS.
DACW43-78-C-0008





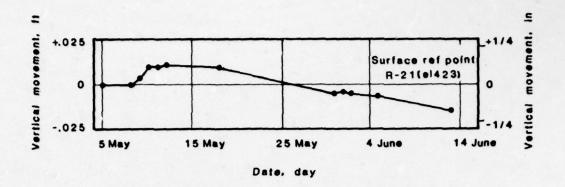


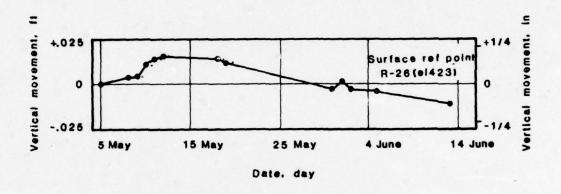


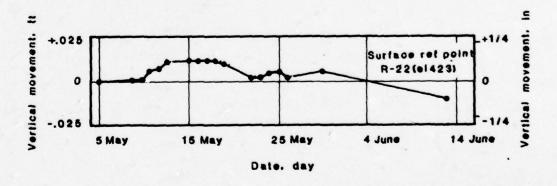
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FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0068

Woodward-Chyde Consultant







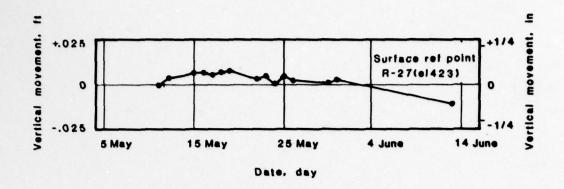
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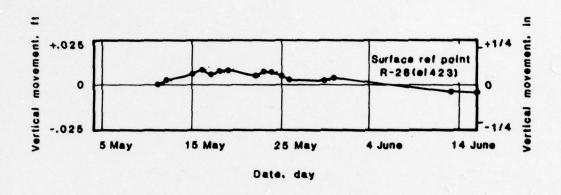
#### CHEMICAL GROUTING TEST PROGRAM

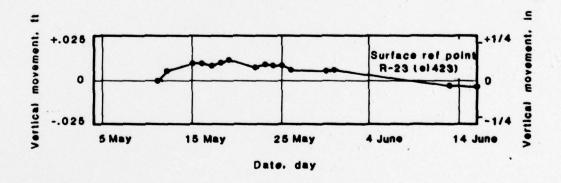
RESULTS OF VERTICAL MOVEMENT MEASUREMENTS SURFACE REFERENCE POINTS R-21, R-26, R-22

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0008

Woodward-Clyde Consultants

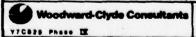


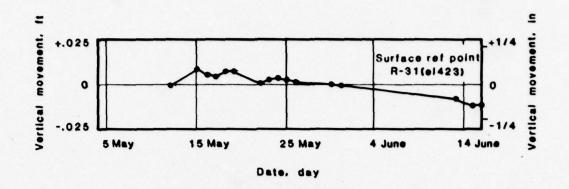


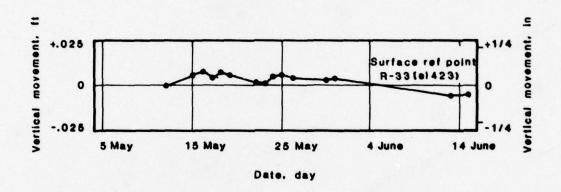


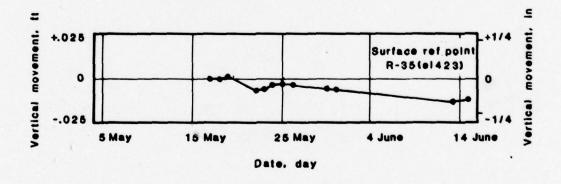
RESULTS OF VERTICAL MOVEMENT MEASURMENTS SURFACE REFERENCE POINTS R-27 R-28, R-23

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS,
DACW43-78-C-0008



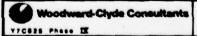


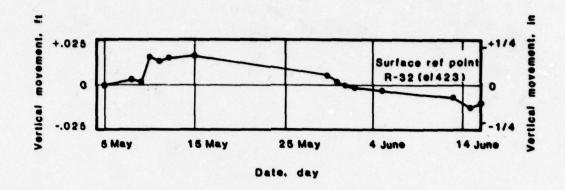


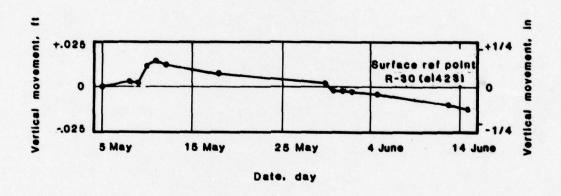


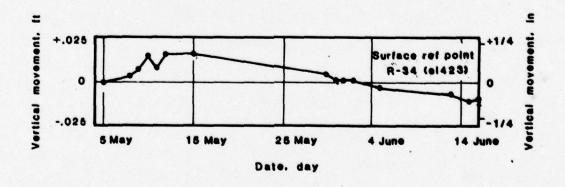
RESULTS OF VERTICAL MOVEMENT MEASUREMENTS SURFACE REFERENCE POINTS R-31, R-33, R-35

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT, CORPS OF ENGINEERS,
DAGW43-78-C-0005



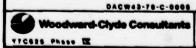


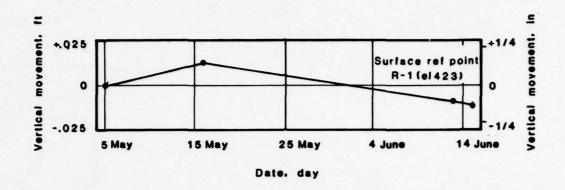


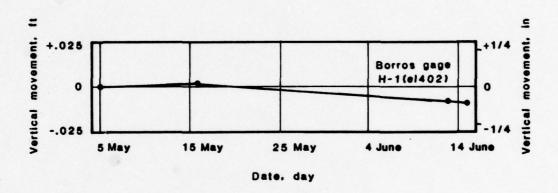


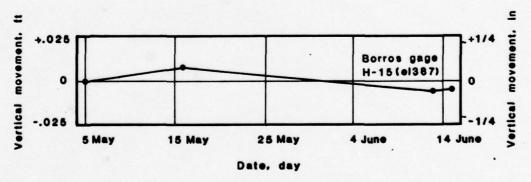
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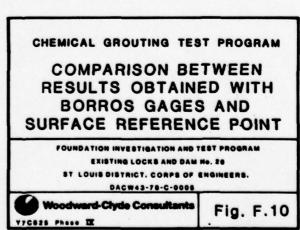
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

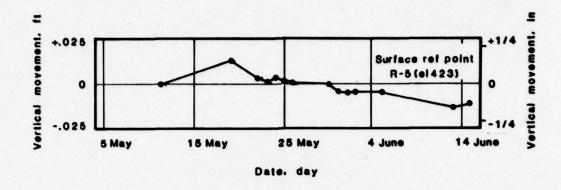


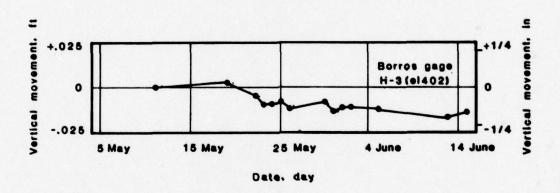


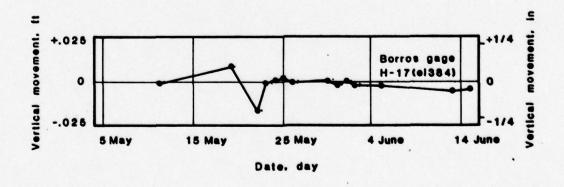






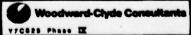


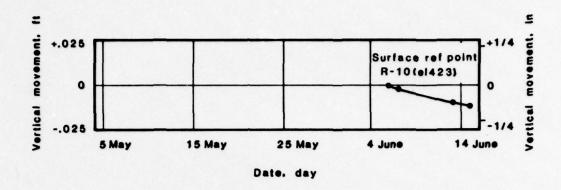


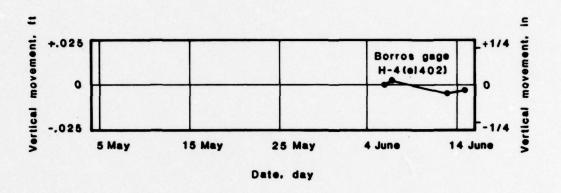


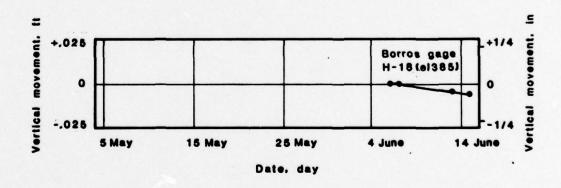
COMPARISON BETWEEN
RESULTS OBTAINED WITH
BORROS GAGES AND
SURFACE REFERENCE POINT

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS,
DACW43-78-C-8008



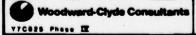


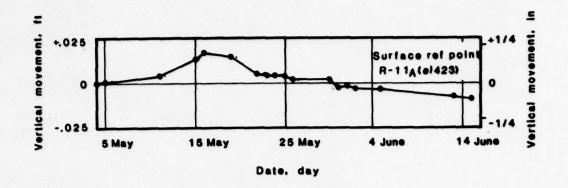


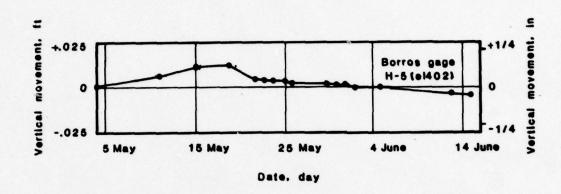


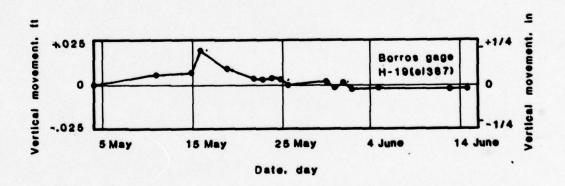
COMPARISON BETWEEN
RESULTS OBTAINED WITH
BORROS GAGES AND
SURFACE REFERENCE POINT

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS,
DACW43-78-C-0005



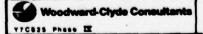


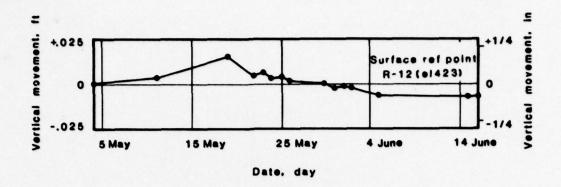


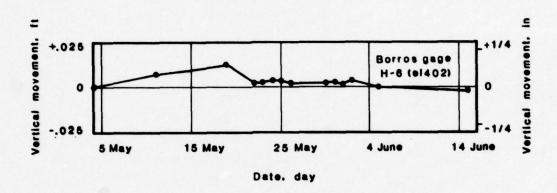


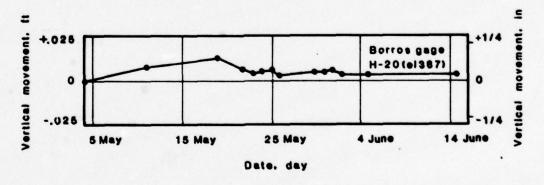
COMPARISON BETWEEN RESULTS OBTAINED WITH BORROS GAGES AND SURFACE REFERENCE POINT

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 29
ST LOUIS DISTRICT, CORPS OF ENGINEERS,
DACW43-78-G-0008









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CHEMICAL GROUTING TEST PROGRAM

COMPARISON BETWEEN

RESULTS OBTAINED WITH

BORROS GAGES AND

SURFACE REFERENCE POINT

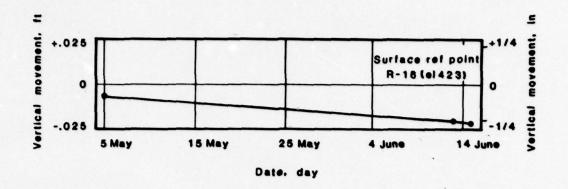
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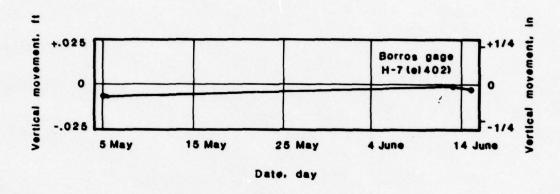
EXISTING LOCKS AND DAM No. 26

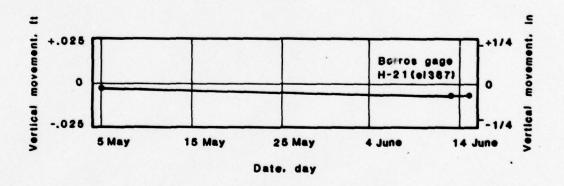
ST LOUIS DISTRICT. CORPS OF ENGINEERS.

DACW43-75-C-9008

Woodward-Clyde Consultants

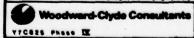


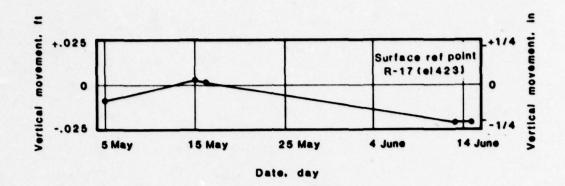


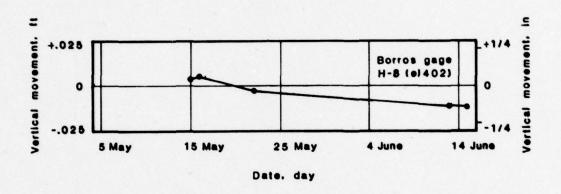


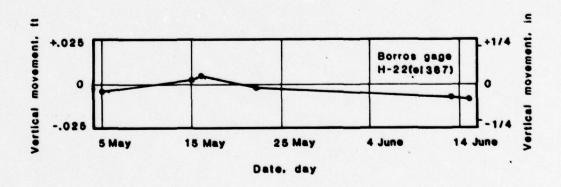
COMPARISON BETWEEN RESULTS OBTAINED WITH BORROS GAGES AND SURFACE REFERENCE POINT

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EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0008



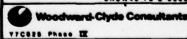


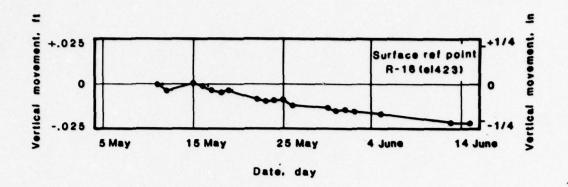


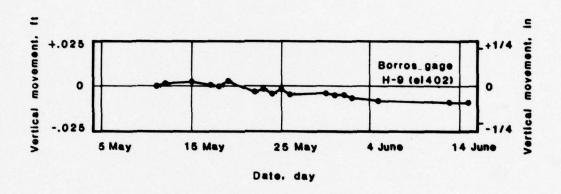


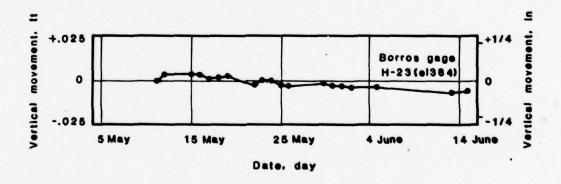
COMPARISON BETWEEN
RESULTS OBTAINED WITH
BORROS GAGES AND
SURFACE REFERENCE POINT

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
OACM43-76-C-0065



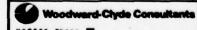


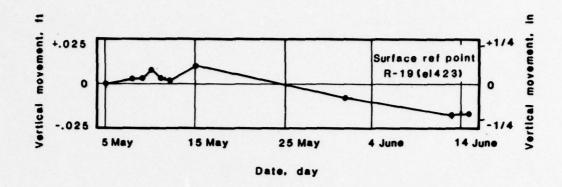


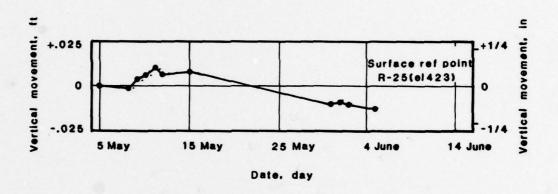


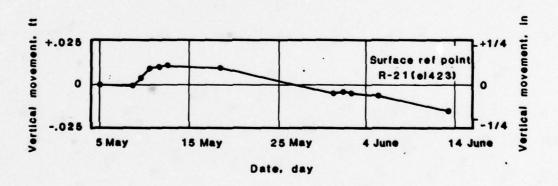
COMPARISON BETWEEN
RESULTS OBTAINED WITH
BORROS GAGES AND
SURFACE REFERENCE POINT

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-G-0008



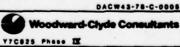


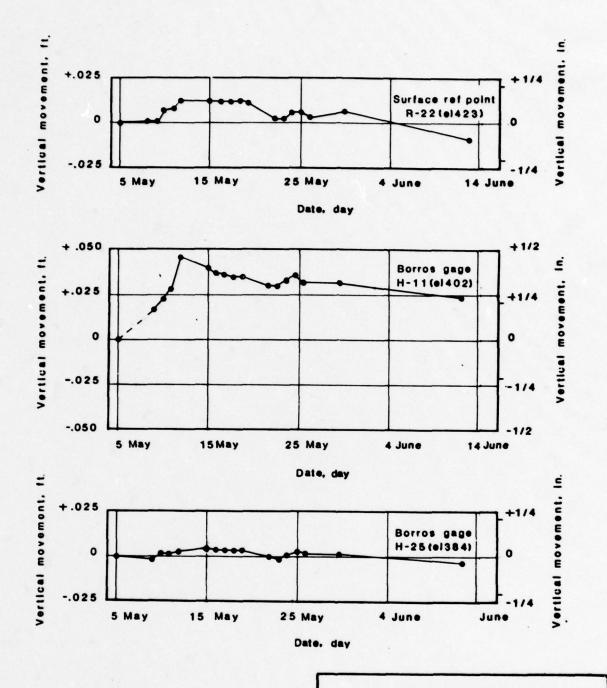


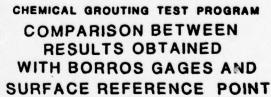


COMPARISON BETWEEN
RESULTS OBTAINED WITH
BORROS GAGES AND
SURFACE REFERENCE POINT

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

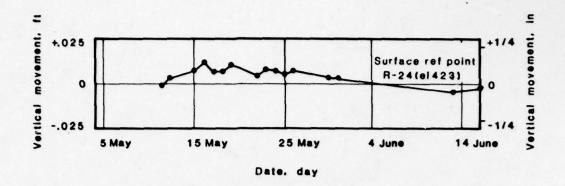






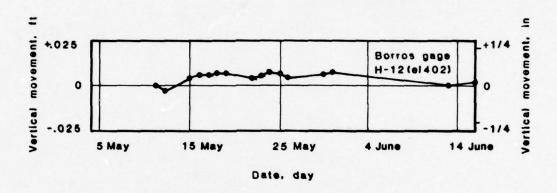
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EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

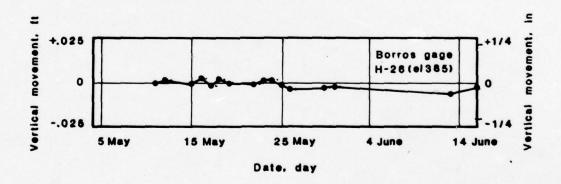
Woodward-Clyde Consultant



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CHEMICAL GROUTING TEST PROGRAM

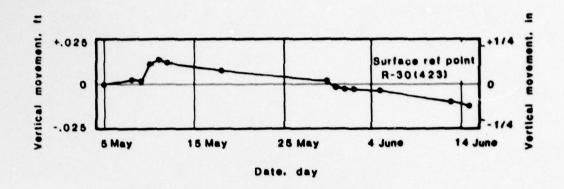
**COMPARISON BETWEEN** RESULTS OBTAINED WITH BORROS GAGES AND SURFACE REFERENCE POINT

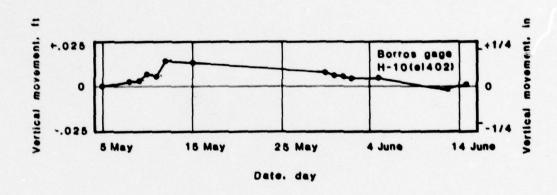
> FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 20 ST LOUIS DISTRICT, CORPS OF ENGINEERS.

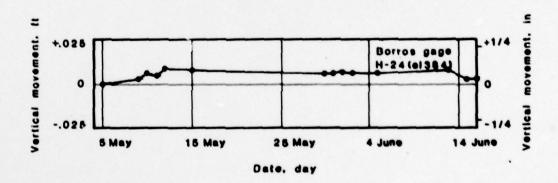
DACW43-78-C-0008

Fig. F.20

**Woodward-Clyde Consultants** Y7C025 Phase IX

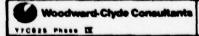


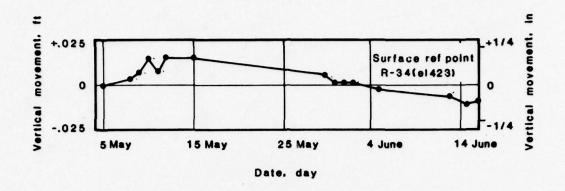


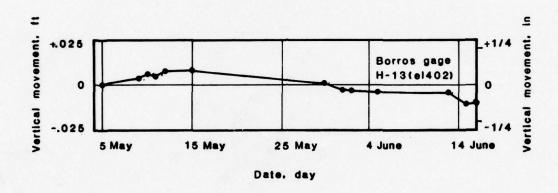


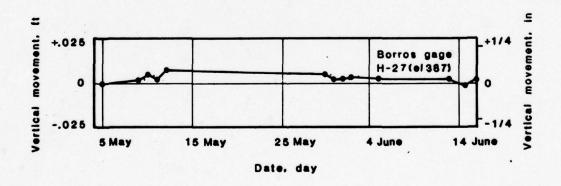
COMPARISON BETWEEN RESULTS OBTAINED WITH BORROS GAGES AND SURFACE REFERENCE POINT

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
57 LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-76-C-0005







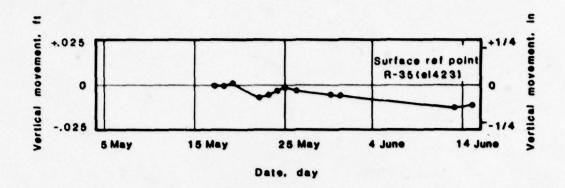


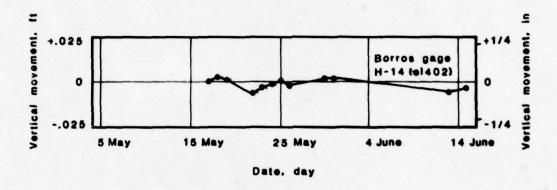
COMPARISON BETWEEN RESULTS OBTAINED WITH BORROS GAGES AND SURFACE REFERENCE POINT

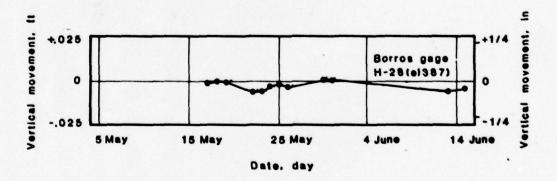
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

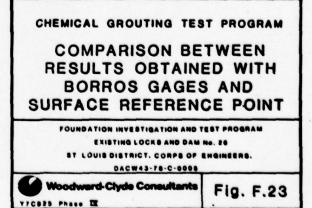
DACW43-78-C-0008
Woodward-Clyde Consultants

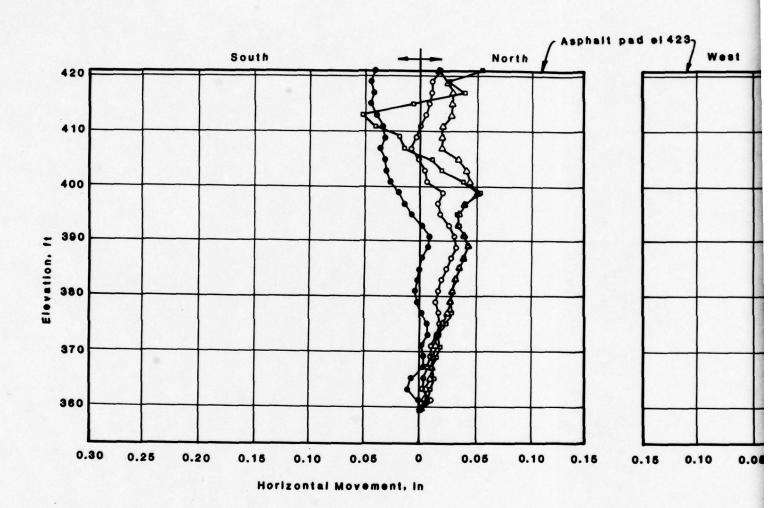
Y7C825 Phase IX





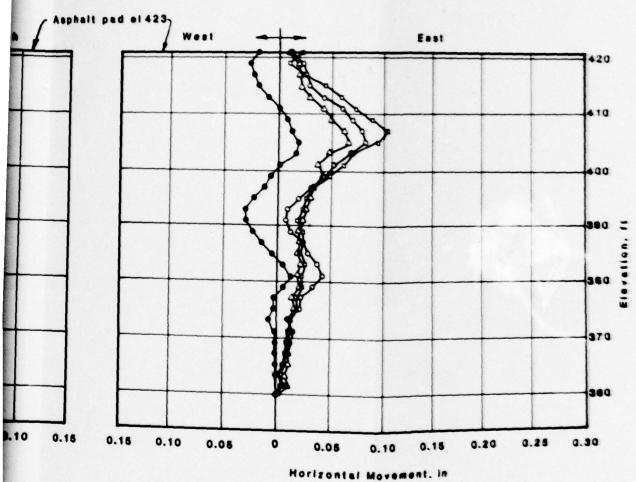


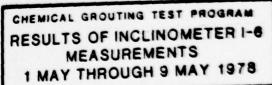




#### Legend

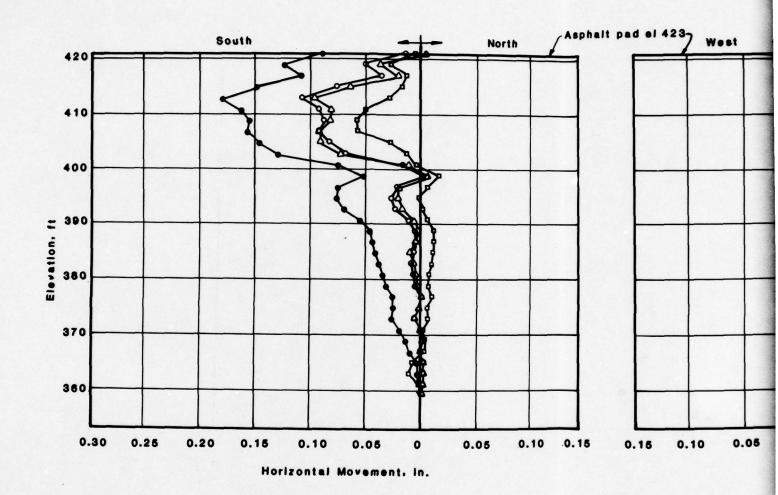
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•	8 May 1978





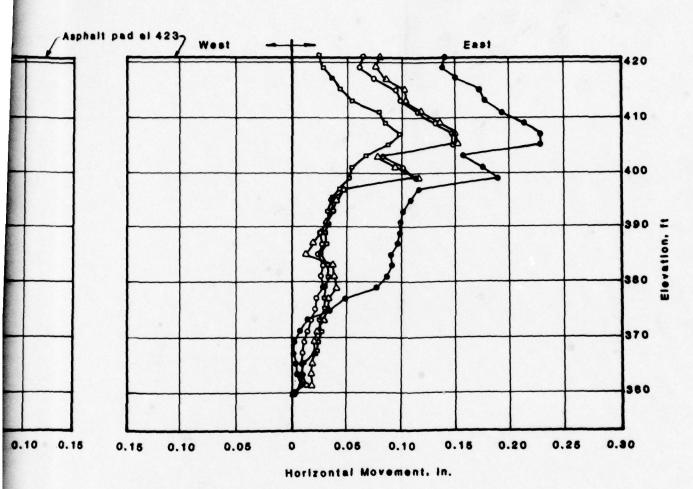
FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26 ST LOUIS DISTRICT, CORPS OF ENGINEERS. 0AC#43-78-C-0008

\*10025 Phase I



#### Legend

Symbol	Date of reading
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•	15 May 1978
•	16 May 1978
۵	17 May 1978

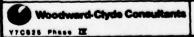


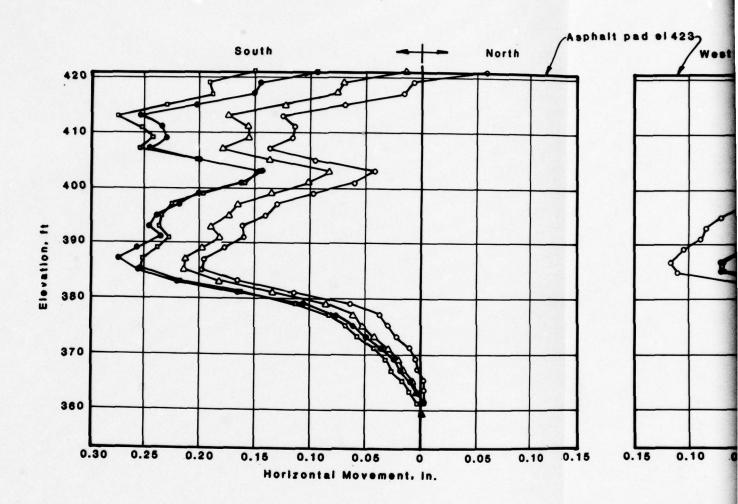
2

RESULTS OF INCLINOMETER 1-6
MEASUREMENTS

10 MAY THROUGH 17 MAY 1978

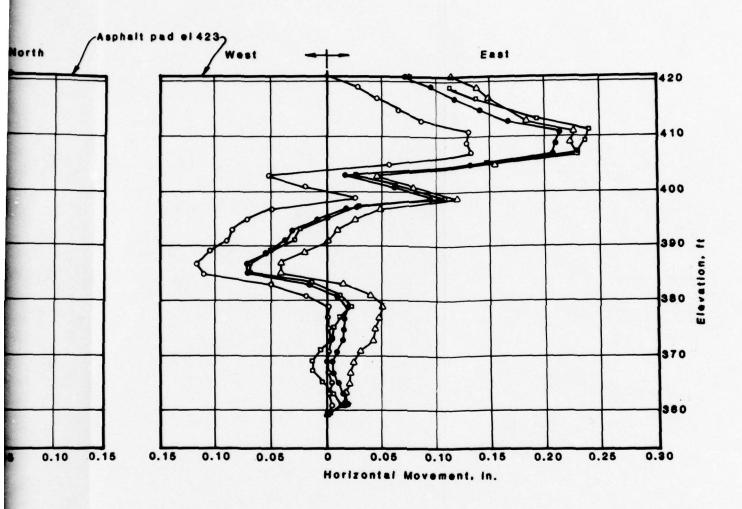
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 25
ST LOUIS DISTRICT, CORPS OF ENGINEERS.
DACW43-78-C-0005





## Symbol Date of reading 18 May 1978

- 19 May 1978
- o 22 May 1978
- Δ 23 May 1978

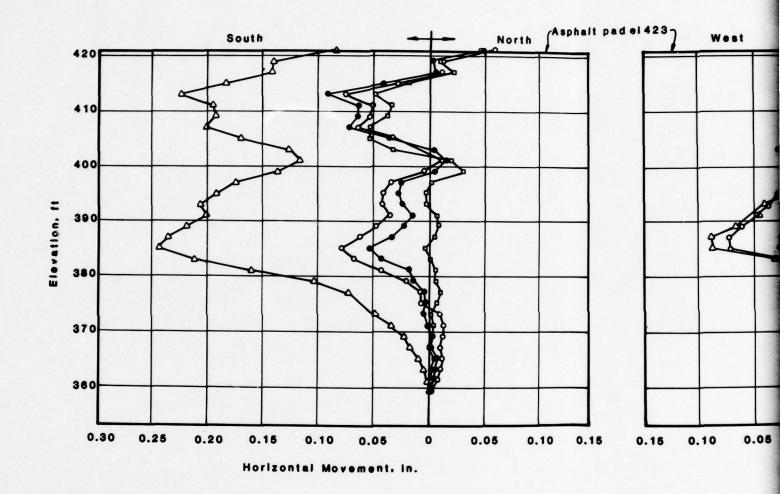




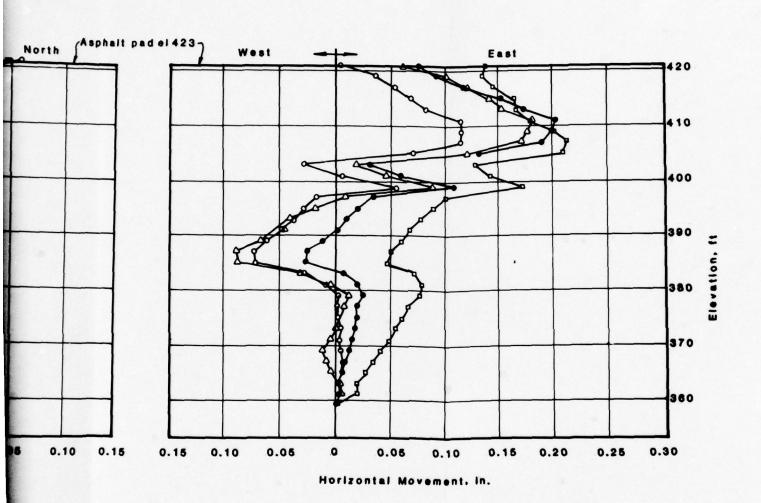
CHEMICAL GROUTING TEST PROGRAM
RESULTS OF INCLINOMETER I-6
MEASUREMENTS
18 MAY THROUGH 23 MAY 1978

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS,
DACW43-78-C-0006

Woodward-Clyde Consultants
Y70828 Phase IX



Legend				
Symbol	Date of reading			
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•	26 May 1978			
•	31 May 1978			
^	14 June 1978			

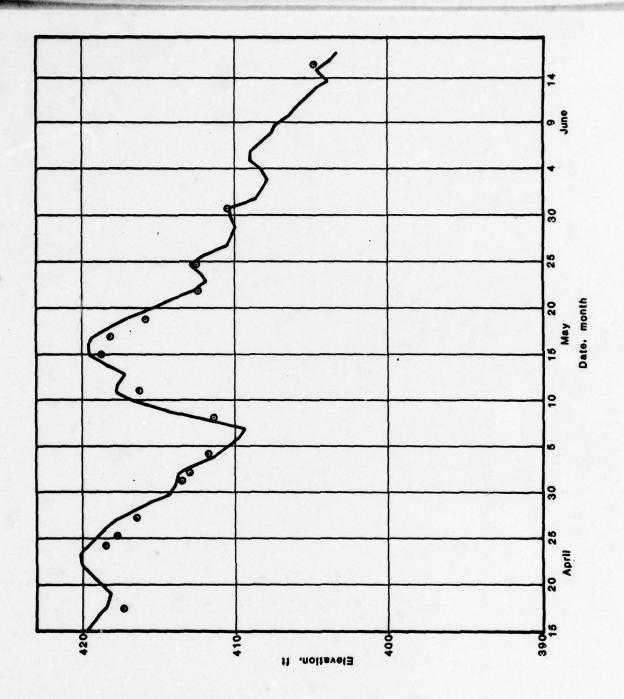


CHEMICAL GROUTING TEST PROGRAM RESULTS OF INCLINOMETER 1-6 **MEASUREMENTS** 25 MAY THROUGH 14 JUNE 1978

> FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26 ST LOUIS DISTRICT. CORPS OF ENGINEERS. DACW43-78-C-0008

**Woodward-Clyde Consultants** 

Fig. F.27 Y7C825 Phase II



#### Legend

Tall water elevation at Locks and Dam No. 26

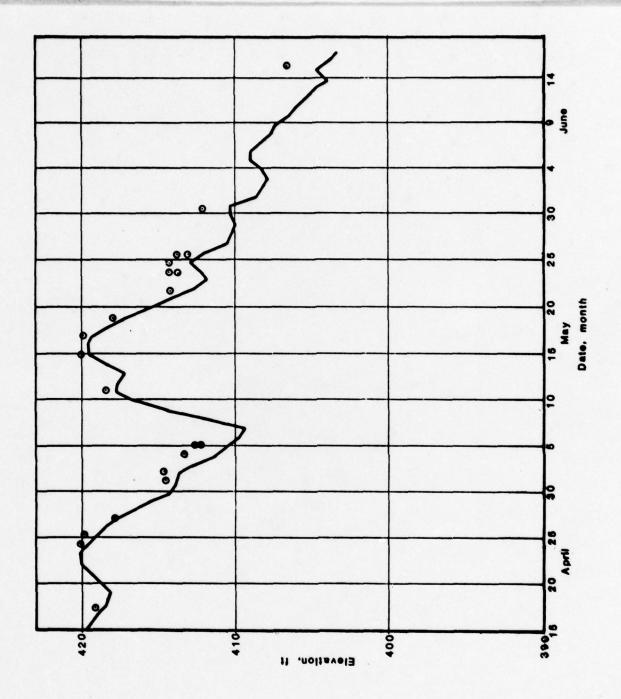
O Plezometric head in P-1

CHEMICAL GROUTING TEST PROGRAM

PIEZOMETRIC HEAD COMPARED TO TAILWATER ELEVATION AT LOCKS AND DAM NO. 26

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DAGW43-78-C-0008

Woodward-Clyde Consultants
Y7C825 Phase 3E



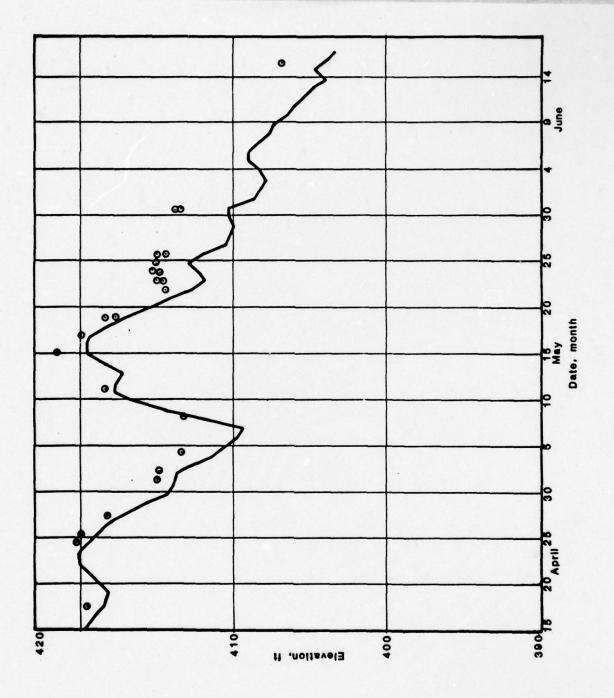
Tail water elevation at Locks and Dam No. 26

O Plezometric head in P-2

PIEZOMETRIC HEAD COMPARED TO TAILWATER ELEVATION AT LOCKS AND DAM NO. 26

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.
DACW43-78-C-0006

Woodward-Clyde Consultants



Locks and Dam No. 26

O Plezometric head in P-3

CHEMICAL GROUTING TEST PROGRAM

PIEZOMETRIC HEAD COMPARED TO TAILWATER ELEVATION AT LOCKS AND DAM NO.

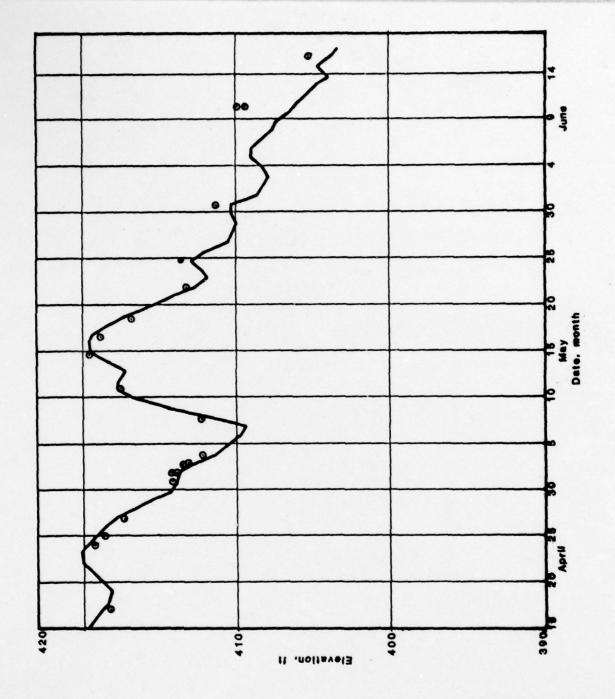
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

DACW43-78-C-0008

Woodward-Clyde Consultants

Fig. F.30

Y7C825 Phase II



Tall water elevation at Locks and Dam No. 26

O Plezometric head in P-4

CHEMICAL GROUTING TEST PROGRAM

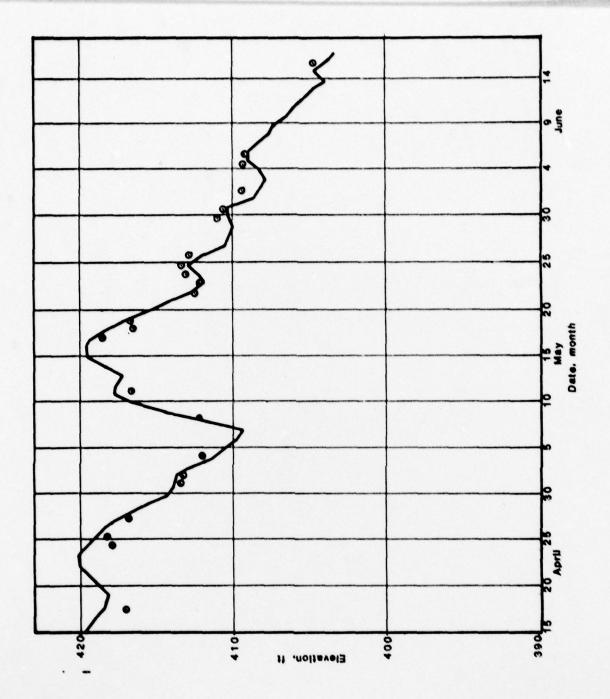
PIEZOMETRIC HEAD COMPARED TO TAILWATER ELEVATION AT LOCKS AND DAM NO. 26

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-76-C-0008

Woodward-Clyde Consultants

Fig.F.31

YTCBES Phase I



Tall water elevation at Locks and Dam No. 26

Plezometric head in P-6

CHEMICAL GROUTING TEST PROGRAM PIEZOMETRIC HEAD COMPARED TO TAILWATER ELEVATION AT LOCKS AND DAM NO. 26

> FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26 ST LOUIS DISTRICT. CORPS OF ENGINEERS.

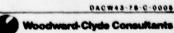
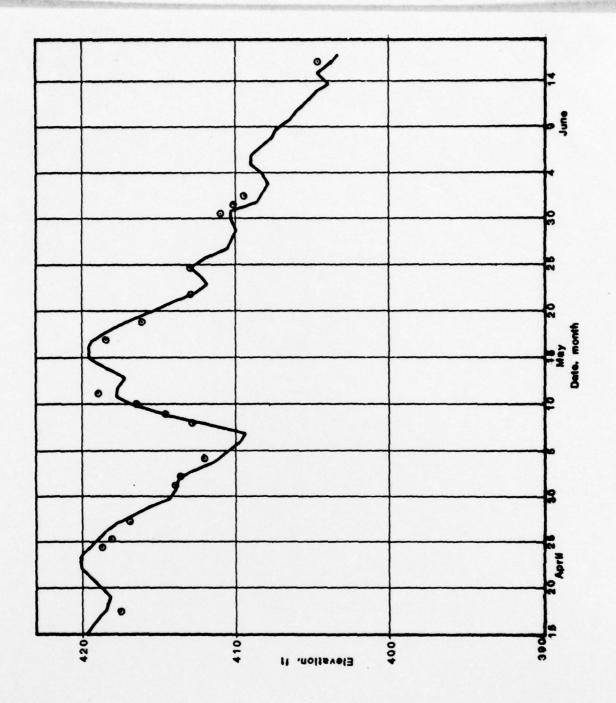


Fig. F.32

**Woodward-Clyde Consultants** Y70828 Phase II



Tall water elevation at Locks and Dam No. 26

O Plezometric head in P-6

PIEZOMETRIC HEAD COMPARED
TO TAILWATER ELEVATION

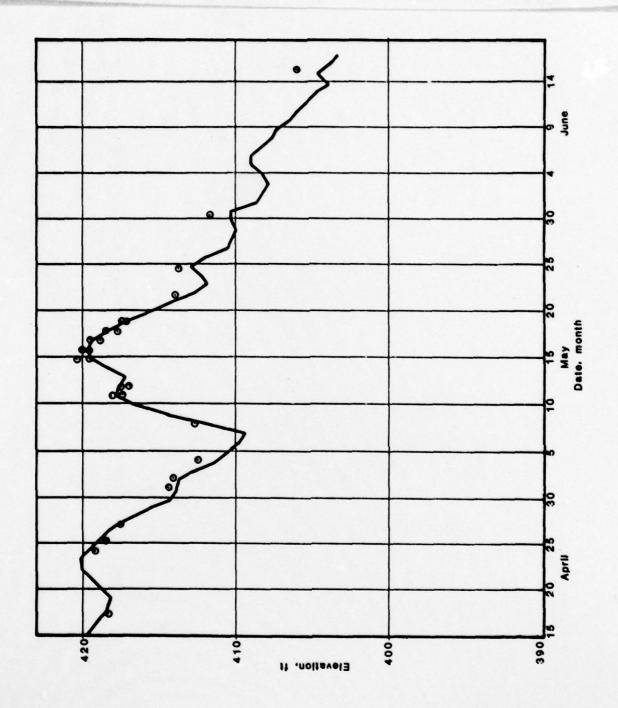
AT LOCKS AND DAM NO. 26

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

DACW43-78-C-0006

Woodward-Clyde Consultants





0

Locks and Dam No. 26

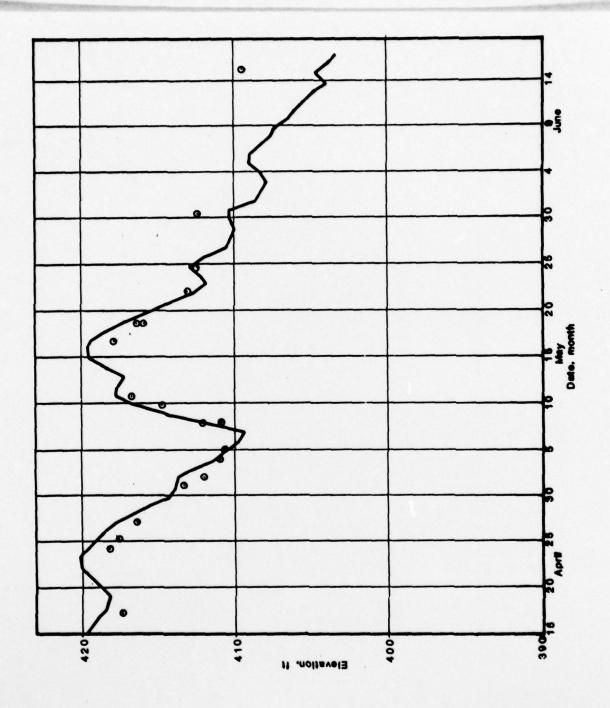
O Plezometric head in P-7

PIEZOMETRIC HEAD COMPARED TO TAILWATER ELEVATION AT LOCKS AND DAM NO. 26

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

DACW43-78-C-0008

Woodward-Chyde Consultants

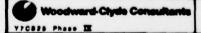


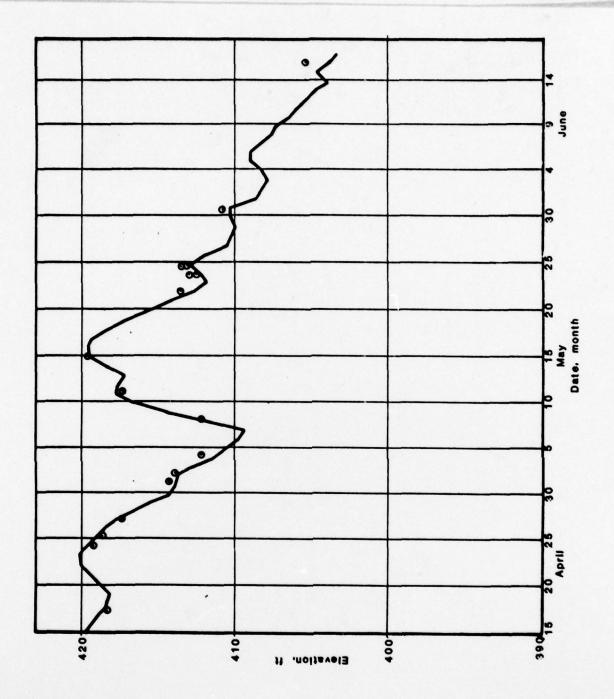
Tall water elevation at Locks and Dam No. 26

O Plezometric head in P-8

PIEZOMETRIC HEAD COMPARED
TO TAILWATER ELEVATION
AT LOCKS AND DAM NO. 26

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0005





Tall water elevation at Locks and Dam No. 28

O Plezometric head in P-9

CHEMICAL GROUTING TEST PROGRAM
PIEZOMETRIC HEAD COMPARED
TO TAILWATER ELEVATION
AT LOCKS AND DAM NO. 26

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. COMPS OF ENGINEERS.
DACW43-78-C-0008

Woodward-Clyde Consultants

Fig. F.36

Y7C825 Phase II

# PHASE IV REPORT VOLUME IIA

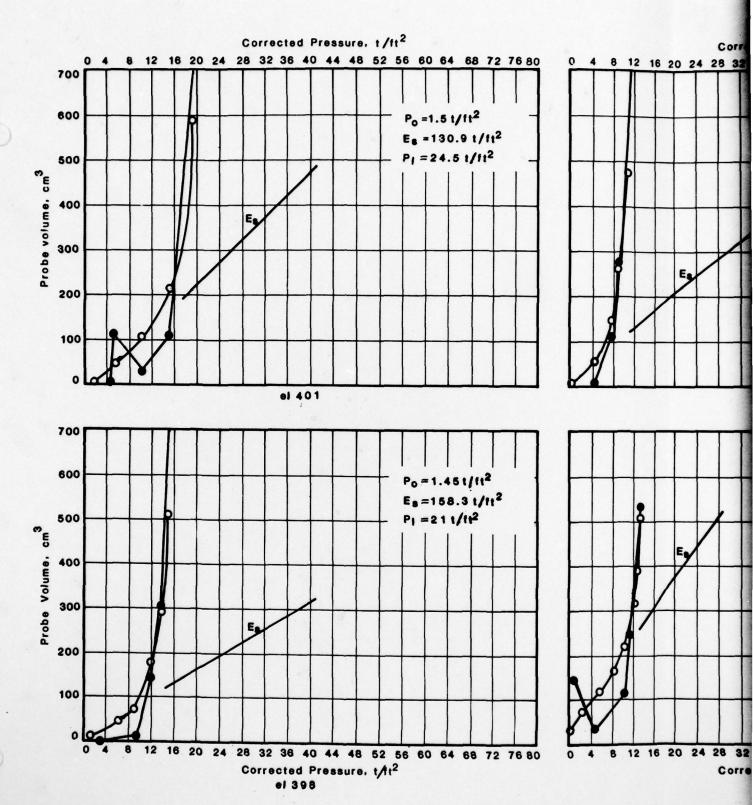
RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM

APPENDIX G
EVALUATION OF GROUTING RESULTS

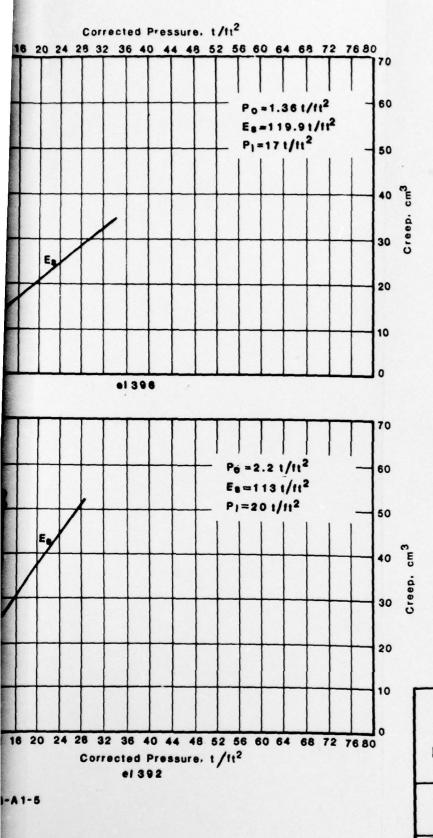
# APPENDIX G EVALUATION OF GROUTING RESULTS

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Test results obtained from boring AG-A1-5



- O Probe Volume Change versus Corrected Pressure
- Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- P. Limit Pressure

2

CHEMICAL GROUTING TEST PROGRAM

PRESSUREMETER TEST
RESULTS AFTER GROUTING
SUBAREA 1

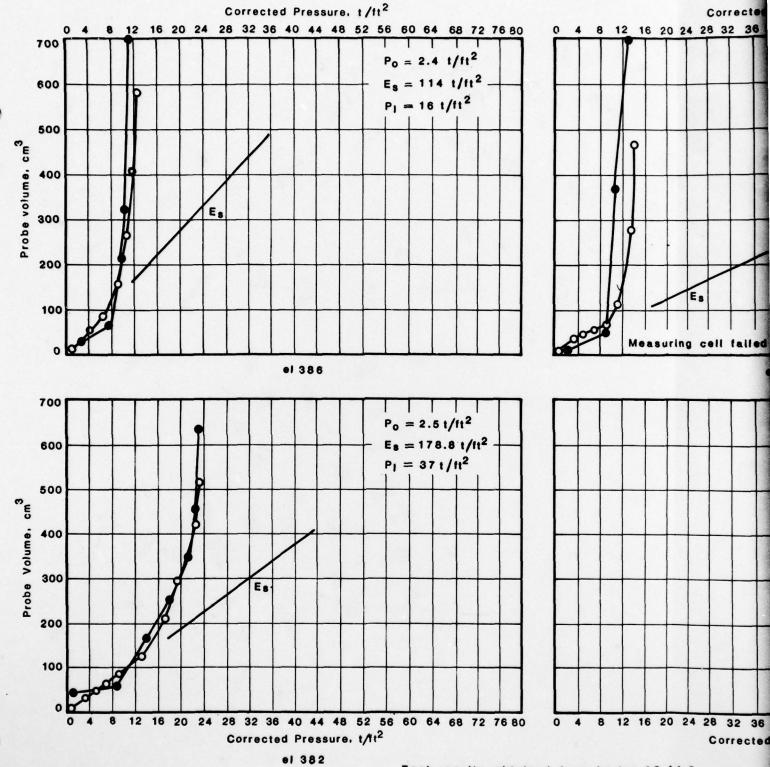
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EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

DACW43-78-C-0005

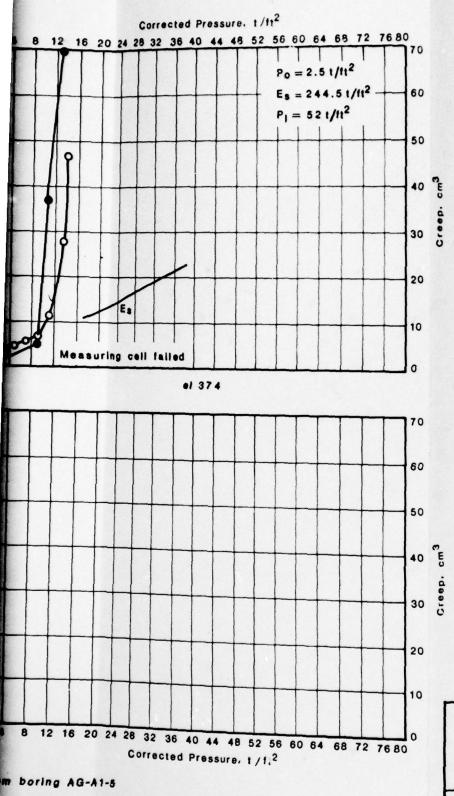
Woodward-Clyde Consultants

Fig. G.1

Y7C825 Phase II



Test results obtained from boring AG-A1-5



- O Probe Volume Change versus Corrected Pressure
- Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- Py Limit Pressure

PRESSUREMETER TEST
RESULTS AFTER GROUTING
SUBAREA 1

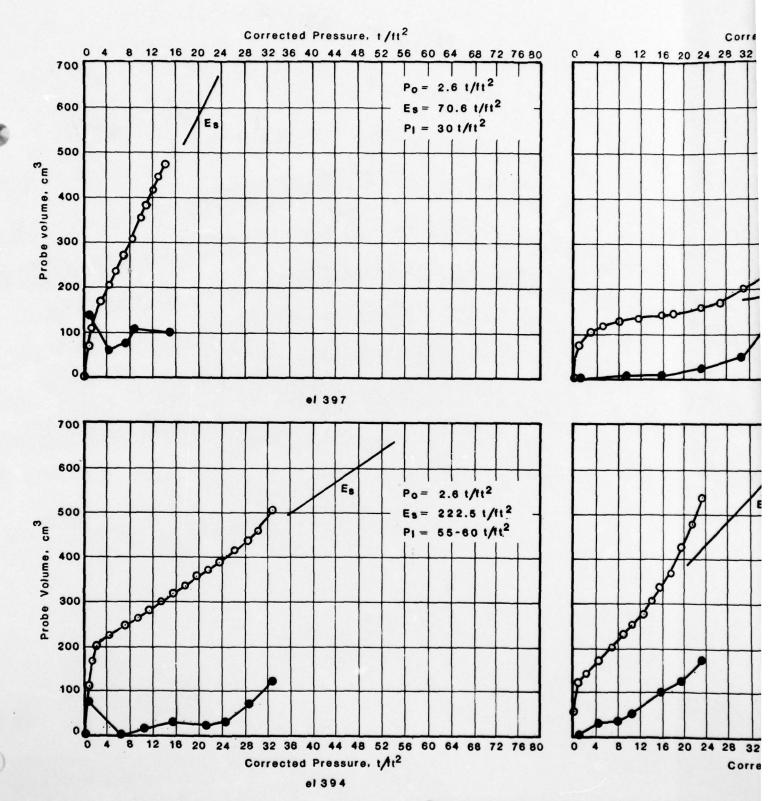
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

DACW43-78-C-0005

Woodward-Clyde Consultants

Fig. G.2

YTCB25 Phase IX



Test results obtained from boring AG-B4-1

Corrected Pressure. 1/11<sup>2</sup>
12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80

Po = 2.6 1/11<sup>2</sup>

Es = 695.9 1/11<sup>2</sup>

Fig. 40 %

Pi = 78 1/11<sup>2</sup>

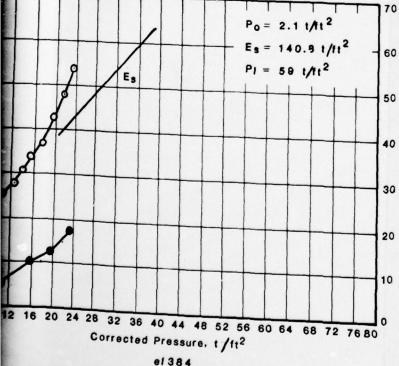
50

40 %

30 %

10





ng AG-84-1

## Legend

- O Probe Volume Change versus Corrected Pressure
- Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- P, Limit Pressure

CHEMICAL GROUTING TEST PROGRAM

# PRESSUREMETER TEST RESULTS AFTER GROUTING SUBAREA 4

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0005

Woodward-Clyde Consultants

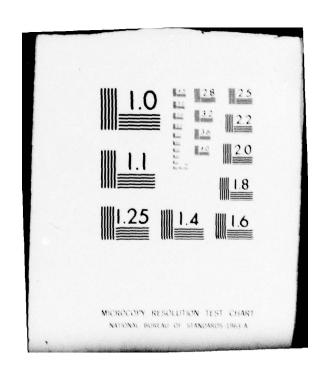
Fig. G.3

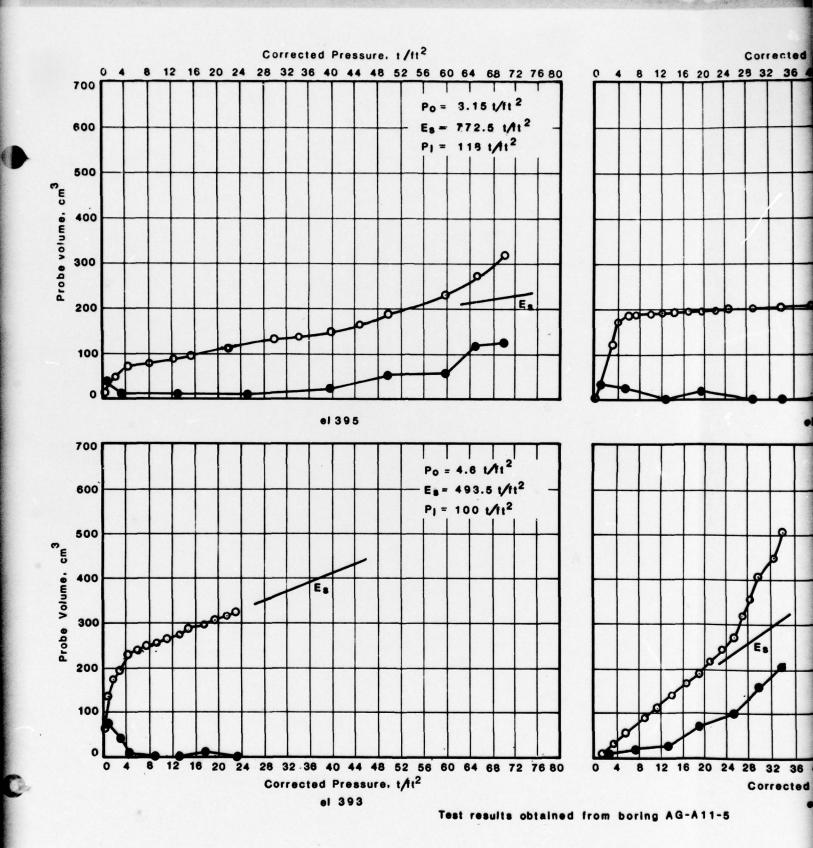
Y7C825 Phase IX

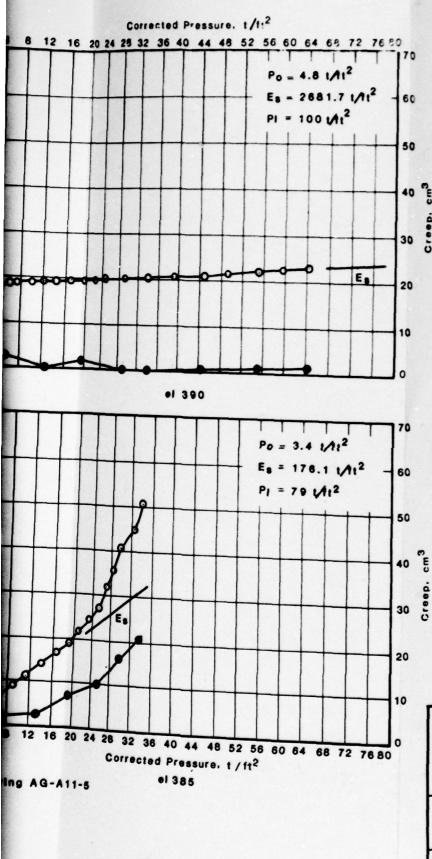
WOODWARD-CLYDE CONSULTANTS CHICAGO IL F/G 13/2 RESULTS AND INTERPRETATION OF CHEMICAL GROUTING TEST PROGRAM. E--ETC(U) JUL 79 J PEREZ , Y LACROIX DACW43-78-C-0005 UNCLASSIFIED NL 3 OF 3 AD A076092 END

AD-A076 092

DATE FILMED 12-79







- O Probe Volume Change versus Corrected Pressure
- Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- P. Limit Pressure

CHEMICAL GROUTING TEST PROGRAM

PRESSUREMETER TEST RESULTS AFTER GROUTING SUBAREA 5

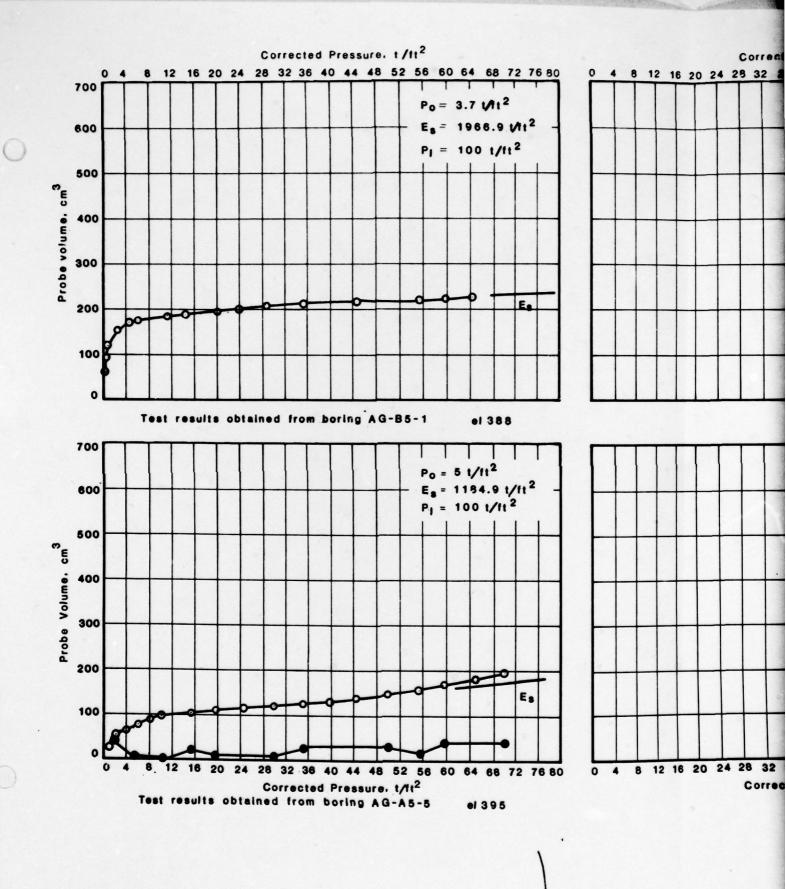
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EXISTING LOCKS AND DAW No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

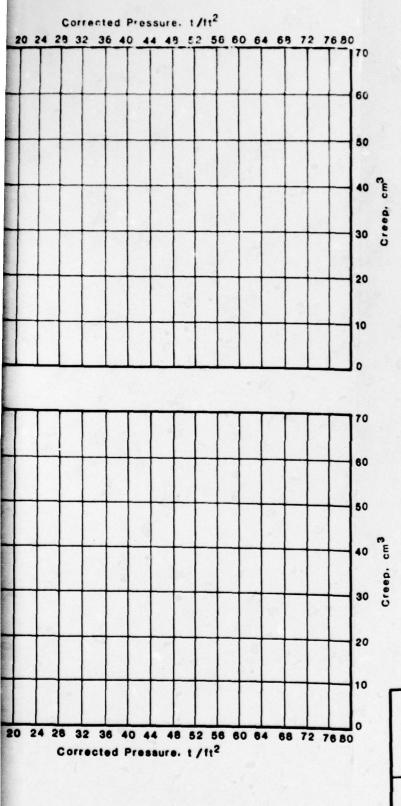
DACW43-78-C-0005

Woodward-Clyde Consultants

Fig. G.4

Y7C825 Phase I





- O Probe Volume Change versus Corrected Pressure
- · Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- P, Limit Pressure

2

CHEMICAL GROUTING TEST PROGRAM

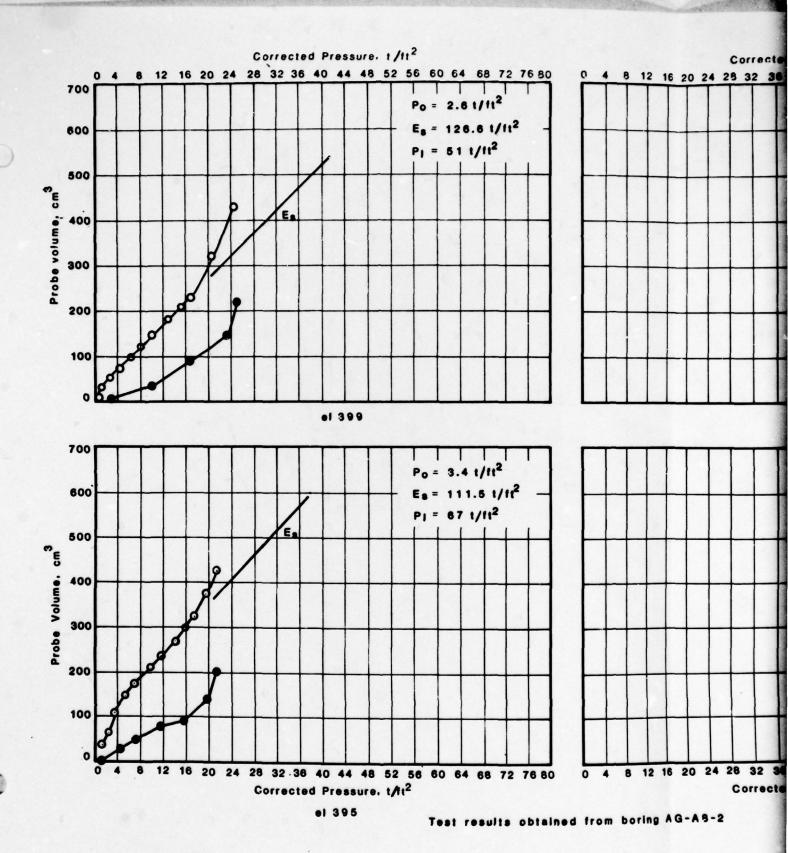
PRESSUREMETER TEST RESULTS AFTER GROUTING SUBAREA 5

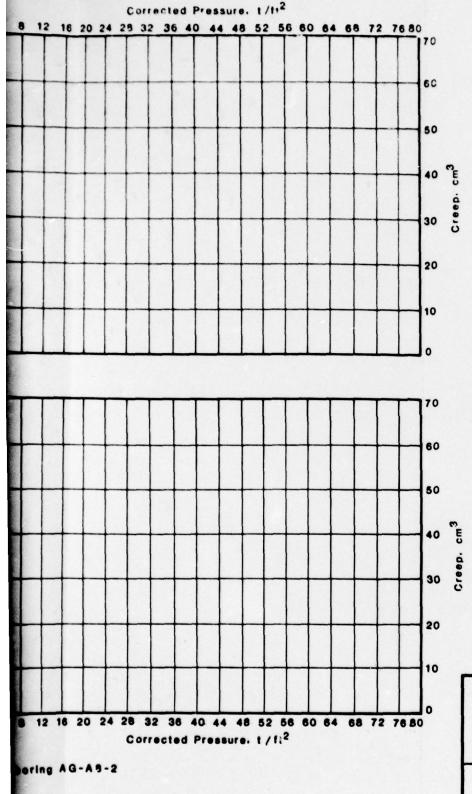
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 24
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

Moodward-Clyde Consultants

Fig. G.5

Y7C825 Phese IX





- O Probe Volume Change versus Corrected Pressure
- · Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- Py Limit Pressure

2

CHEMICAL GROUTING TEST PROGRAM

# PRESSUREMETER TEST RESULTS AFTER GROUTING SUBAREA 8

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.
DACW43-78-C-0005

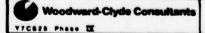
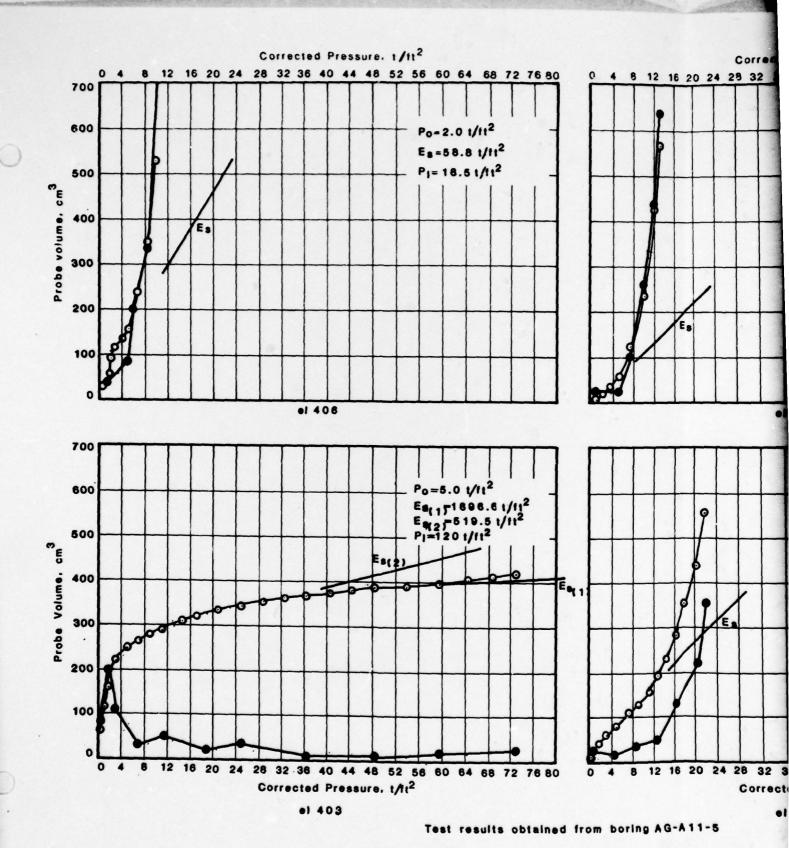
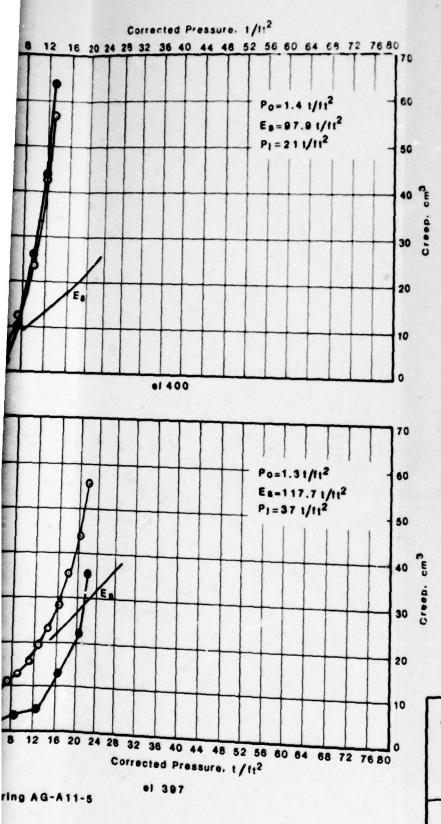


Fig. G.8





CHEMICAL GROUTING TEST PROGRAM

Legend

Pi Limit Pressure

O Probe Volume Change versus Corrected Pressure

Po in Situ Horizontal Stress Es Elastic Deformation Modulus

· Creep versus Corrected Pressure

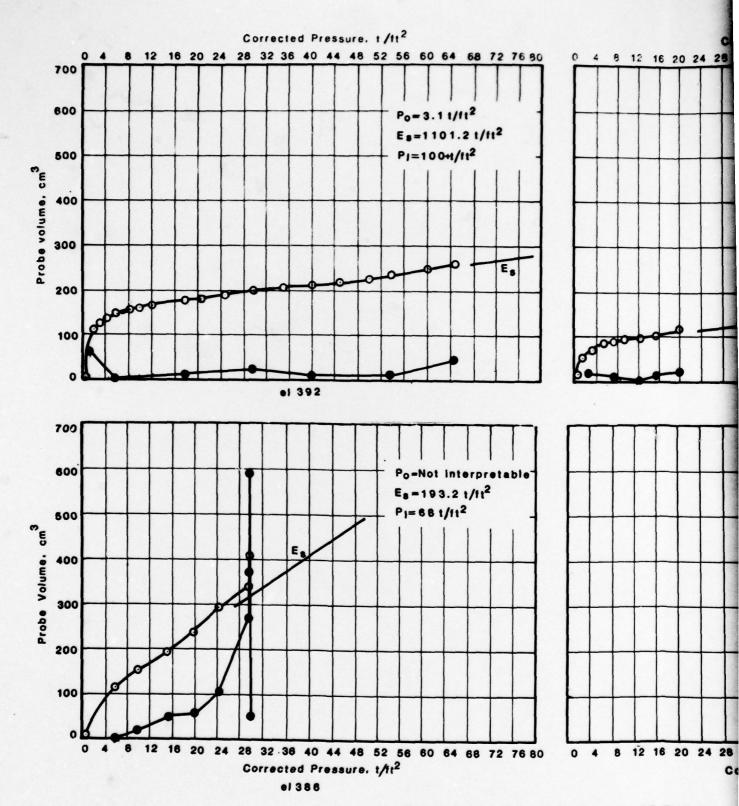
PRESSUREMETER TEST RESULTS AFTER GROUTING SUBAREA 11

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.
DACW43-78-C-0003

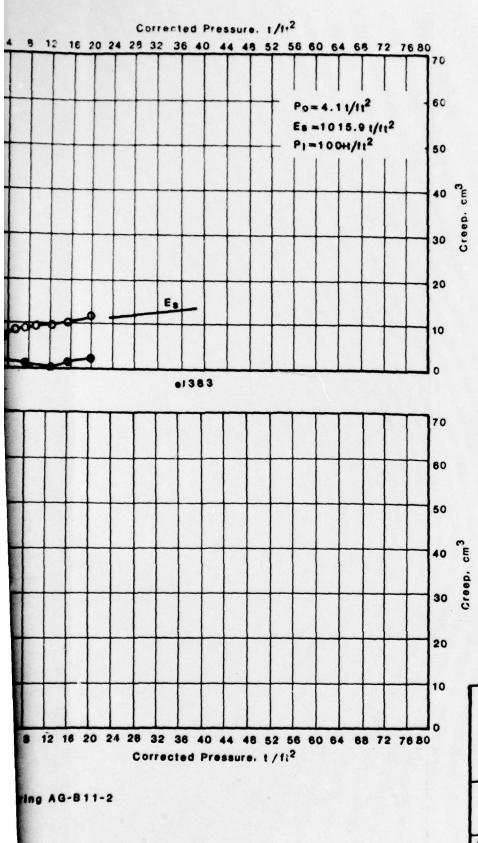
Woodward-Clyde Consultants

Fig. G.7

VICE25 PRODE II



Test results obtained from boring AG-B11-2



- O Probe Volume Change versus Corrected Pressure
- Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- Py Limit Pressure

2

CHEMICAL GROUTING TEST PROGRAM

PRESSUREMETER TEST RESULTS AFTER GROUTING SUBAREA 11

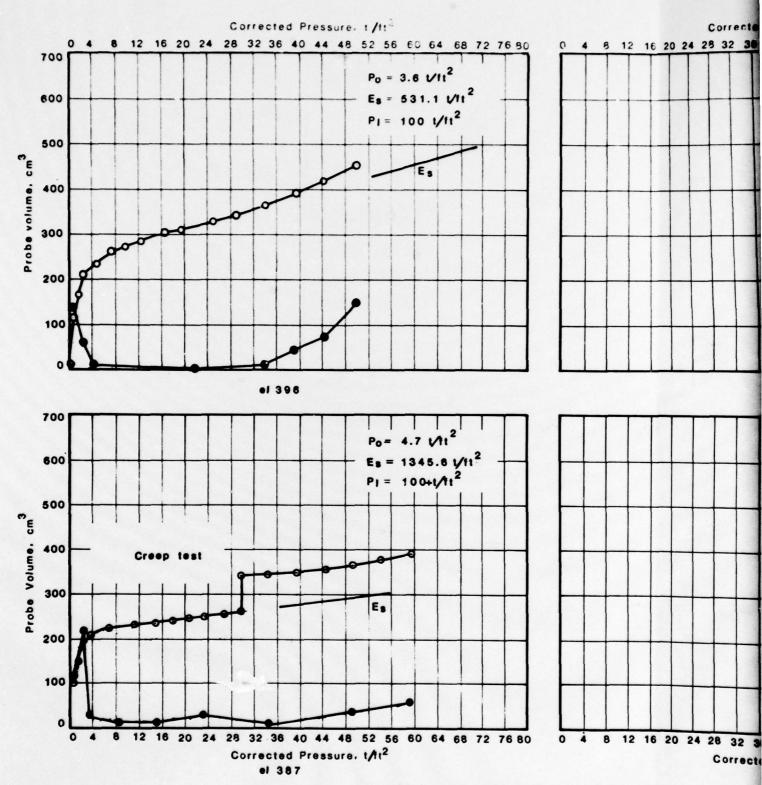
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EXISTING LOCKS AND DAM No. 28
ST LOUIS DISTRICT. CORPS OF ENGINEERS.

DACW43-78-C-0005

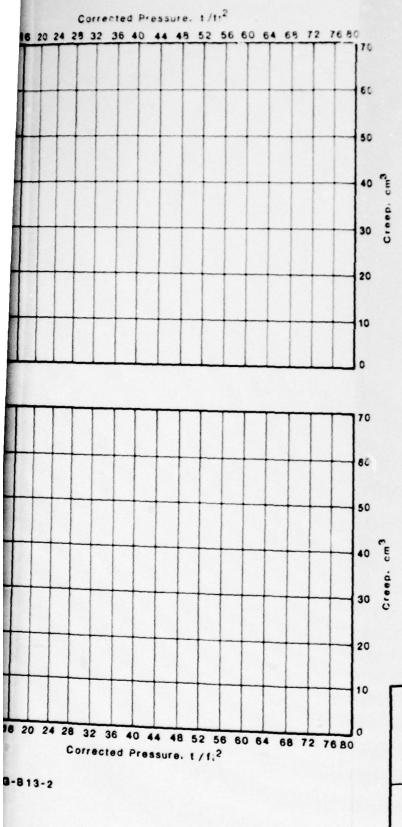
Woodward-Clyde Consultants

YTCB25 Phase IX

Fig. G.8



Test results obtained from boring AG-B13-2



- O Probe Volume Change versus
  Corrected Pressure
- Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- Py Limit Pressure

CHEMICAL GROUTING TEST PROGRAM

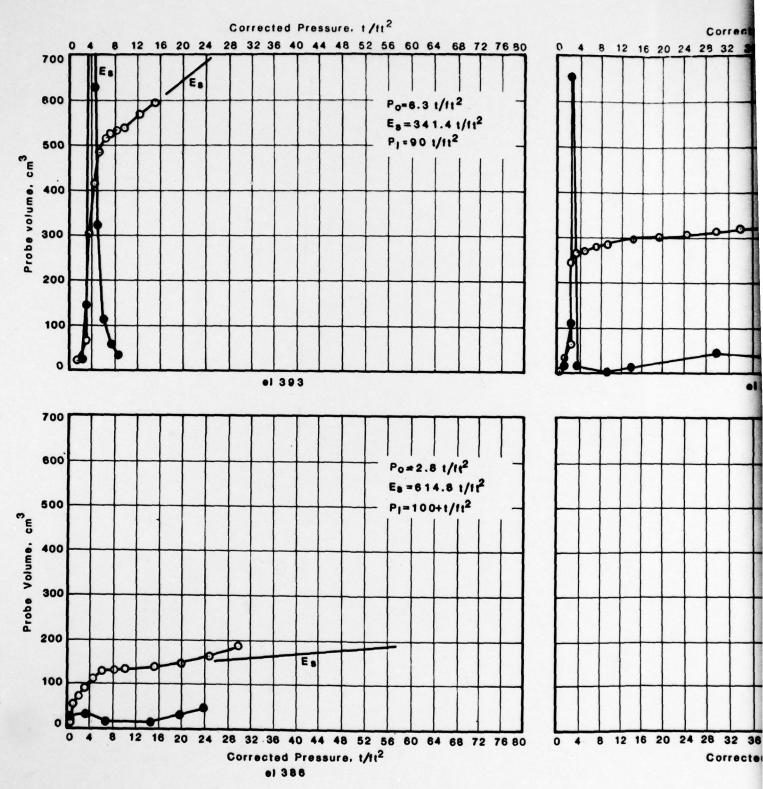
PRESSUREMETER TEST RESULTS AFTER GROUTING SUBAREA 13

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM NO 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS
DACW43-78-C-0005

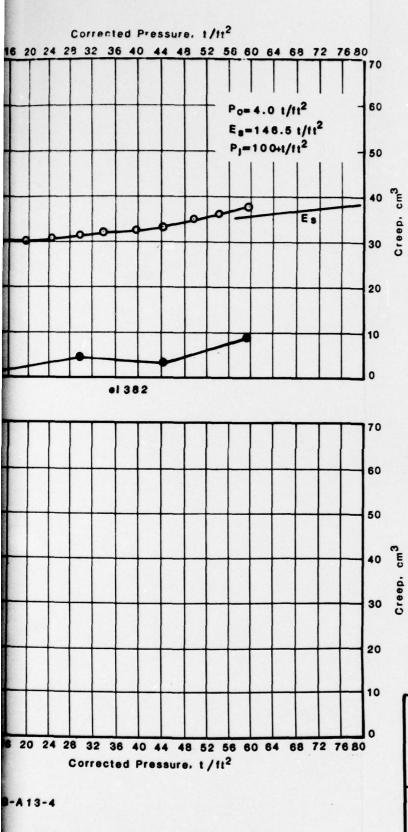
Woodward-Clyde Consultants

Fig. G.9

VICEZS PRESS IS



Test results obtained from boring AG-A13-4



- O Probe Volume Change versus Corrected Pressure
- Creep versus Corrected Pressure
- Po In Situ Horizontal Stress
- Es Elastic Deformation Modulus
- P<sub>1</sub> Limit Pressure

CHEMICAL GROUTING TEST PROGRAM

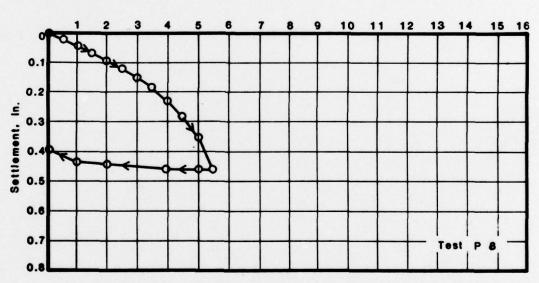
# PRESSUREMETER TEST RESULTS AFTER GROUTING SUBAREA 13

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26 ST LOUIS DISTRICT. CORPS OF ENGINEERS. DACW43-78-C-0008

**Woodward-Clyde Consultants** 

Fig. G. 10

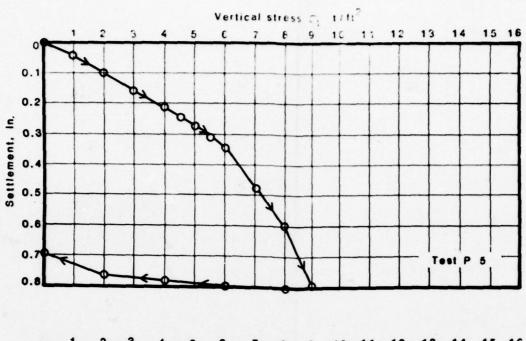
Y7C825 Phase II



Settlement, In.

Settlement. In.





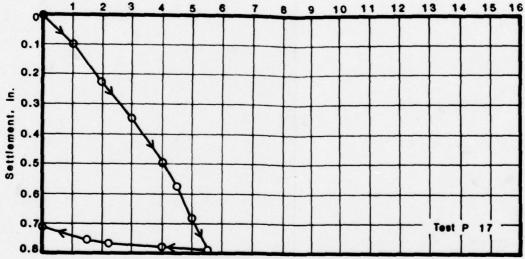




PLATE LOAD TEST RESULTS FOR UNGROUTED SOIL

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

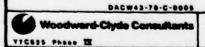
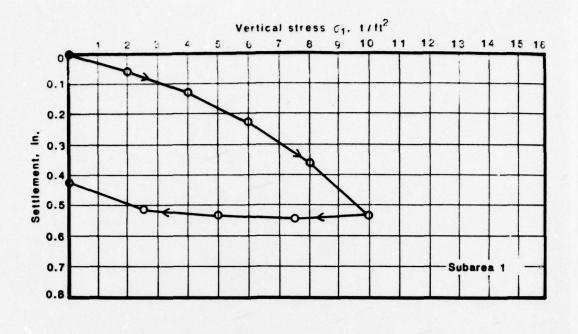
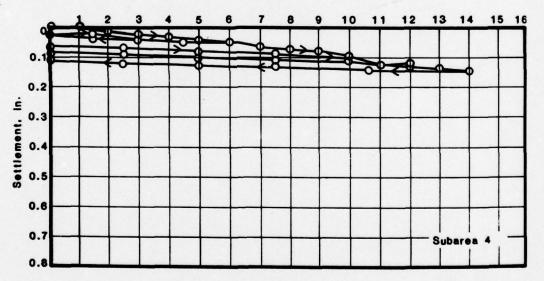


Fig.G.11





0.1

0.2

Settlement, In. 0.3 0.4

0.5

0.6

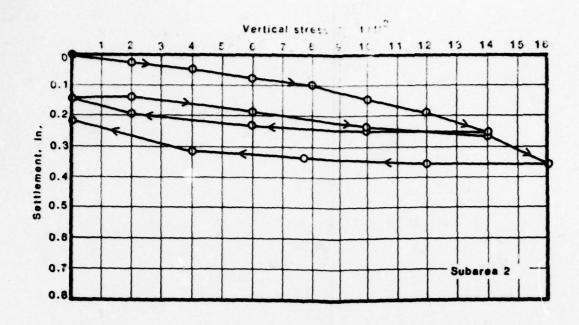
0.7 0.8

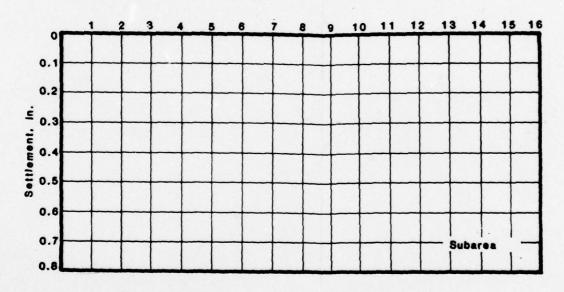
0.1 0.2

0.4 0.4 0.5 0.5

0.0

0.7 0.8







## CHEMICAL GROUTING TEST PROGRAM

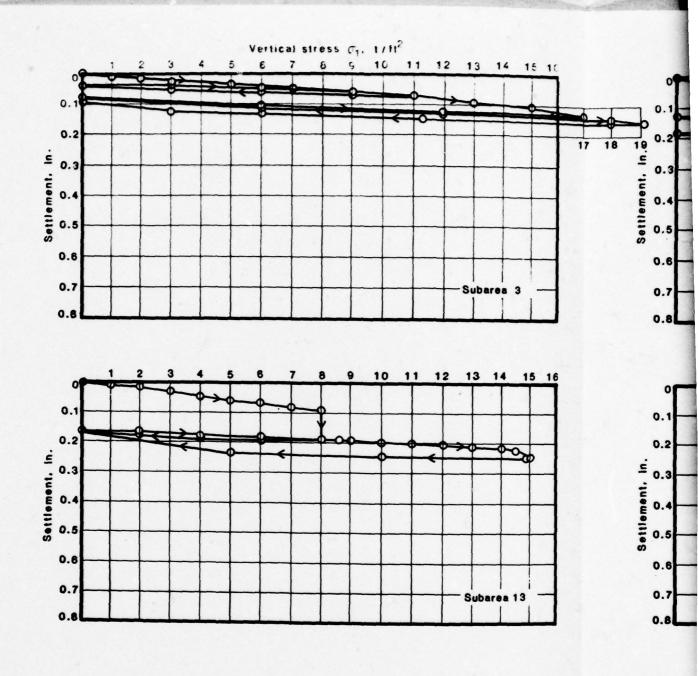
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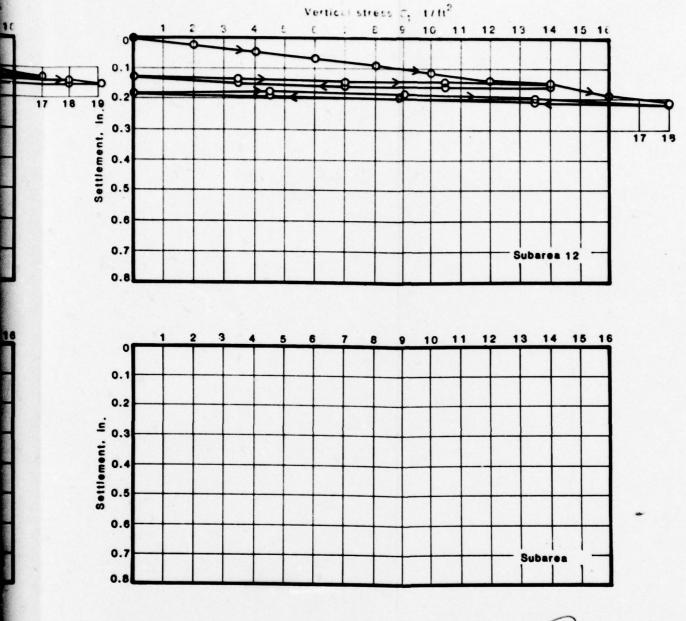
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

Woodward-Clyde Consult

YTC825 Phase II

Fig. G. 12







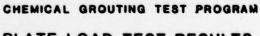
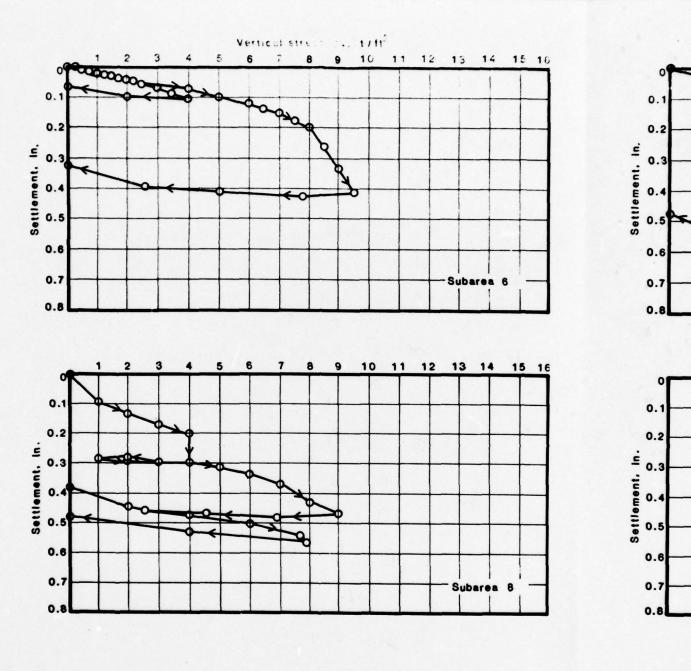


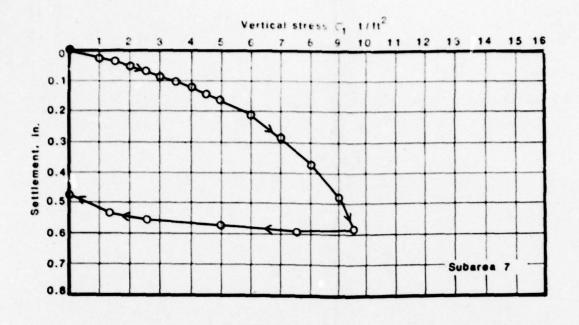
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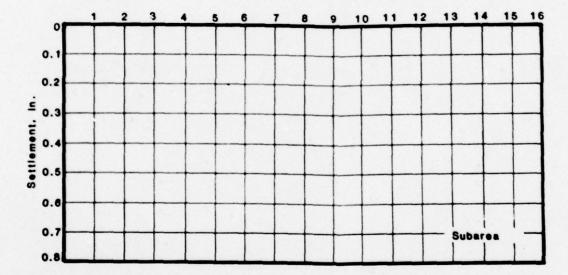
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-9005

Woodward-Clyde Consultant

YTCO25 Phose II









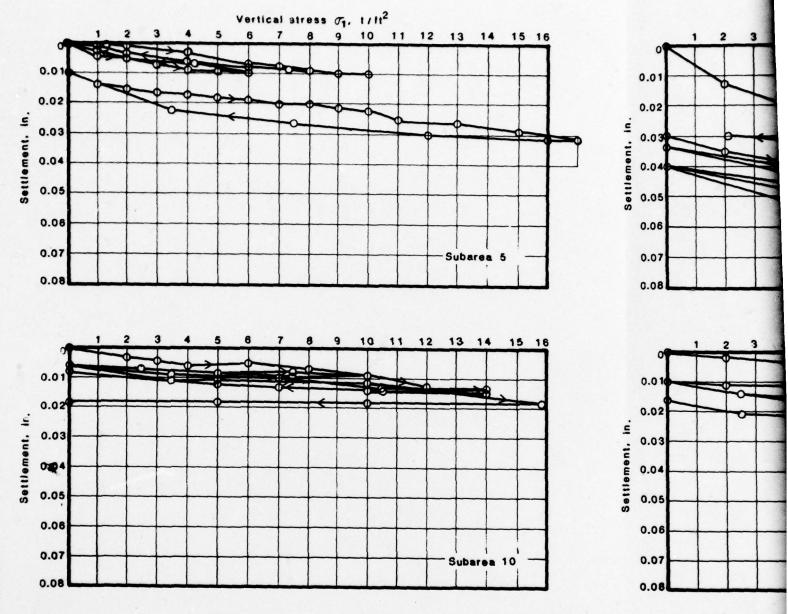
CHEMICAL GROUTING TEST PROGRAM

PLATE LOAD TEST RESULTS FOR SUBAREAS 6.7.8

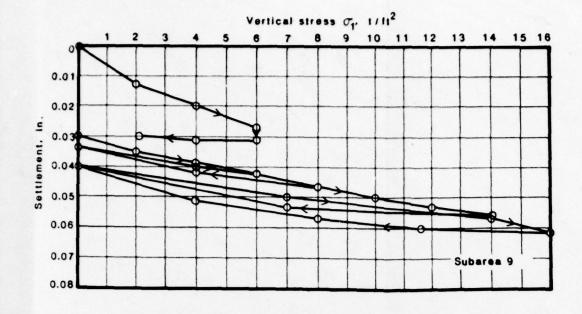
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EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-8005

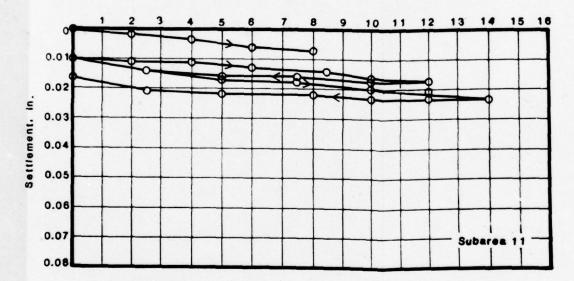


Woodward-Clyde Consultan



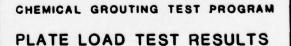
Note: Settlement scale increased 10 times to 10-1 in/divisie





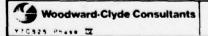
acreased 10 times to 10<sup>-1</sup> in/division

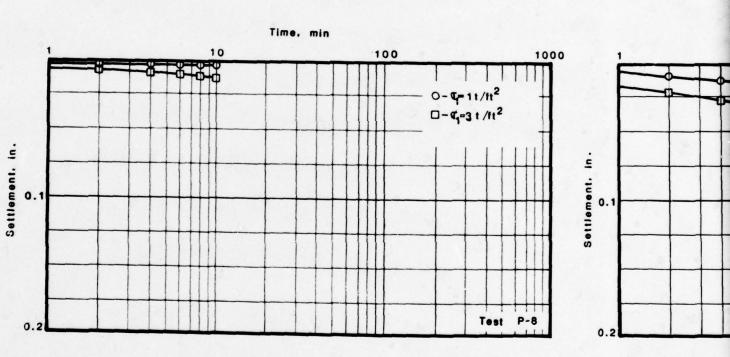


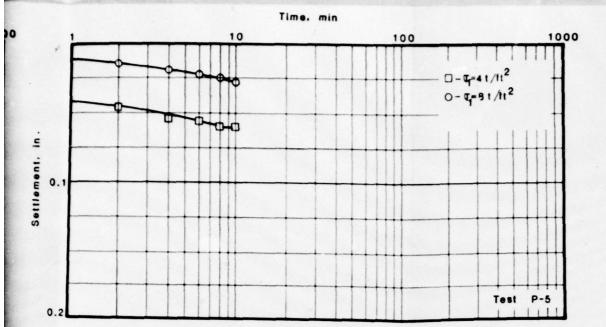


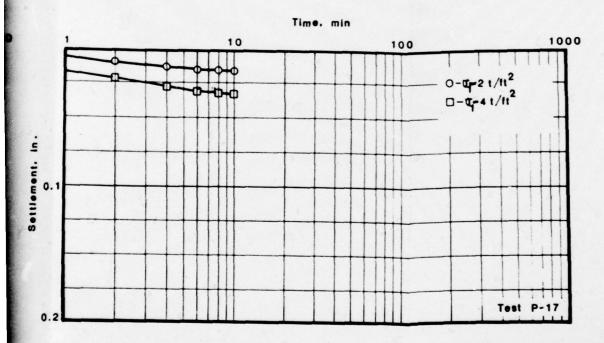
FOR SUBAREAS 5.9.10.11

OUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0005











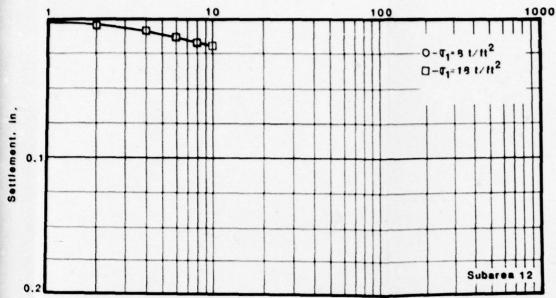
### CHEMICAL GROUTING TEST PROGRAM CREEP RESULTS FROM PLATE LOAD TEST UNGROUTED SOIL

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26 ST LOUIS DISTRICT. CORPS OF ENGINEERS.

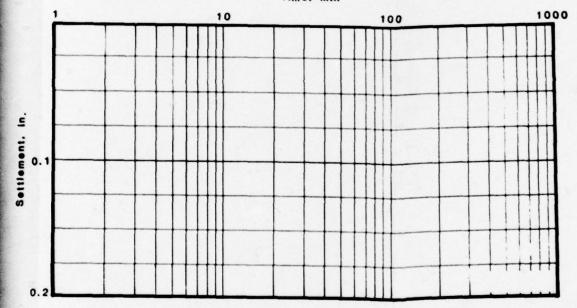
Woodward-Clyde Consultants

Y70325 PHASE IZ





#### Time. min



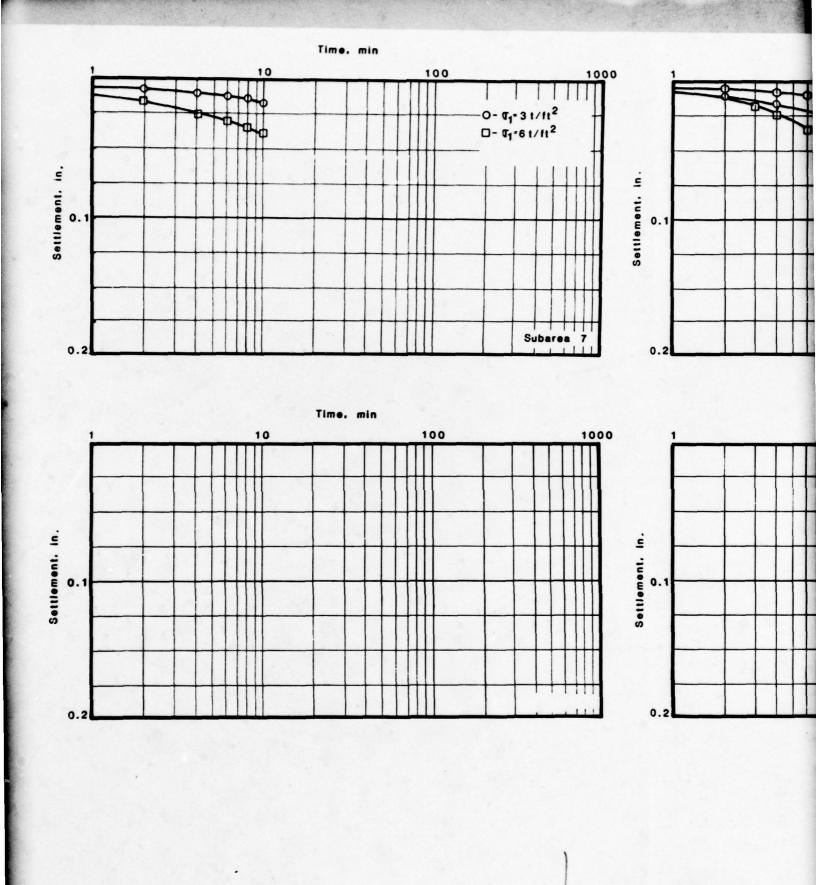
### 2

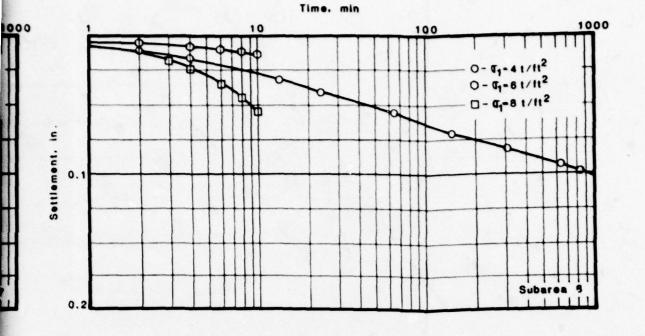
## CHEMICAL GROUTING TEST PROGRAM CREEP RESULTS FROM PLATE LOAD TEST SUBAREAS 3,12,13

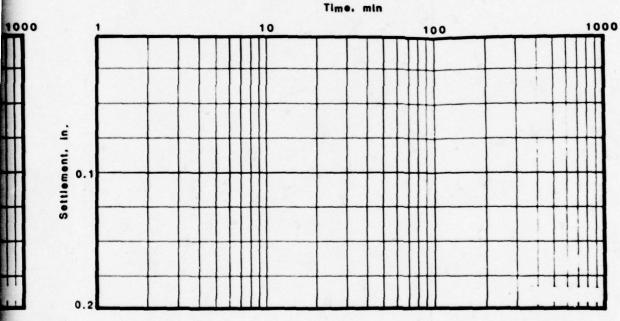
FOUNDATION INVESTIGATION AND TEST PROGRAM
SOSTING LOCKS AND DAM No. 26
ST LOGIS DISTRICT, CORPS OF ENGINEERS.

34CW43-78-C-0005

Woodward-Clyde Consultants







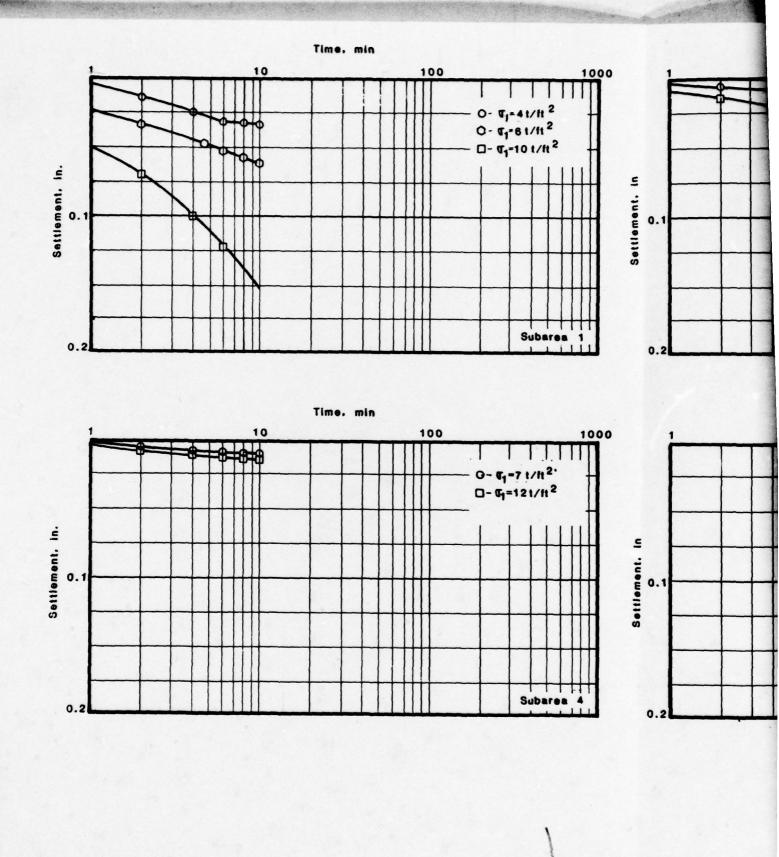


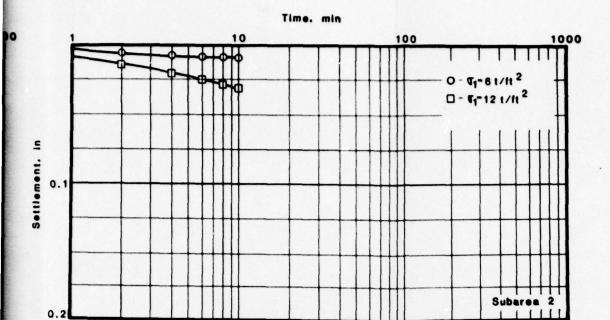
CREEP RESULTS FROM
PLATE LOAD TEST.
SUBAREAS 7.8

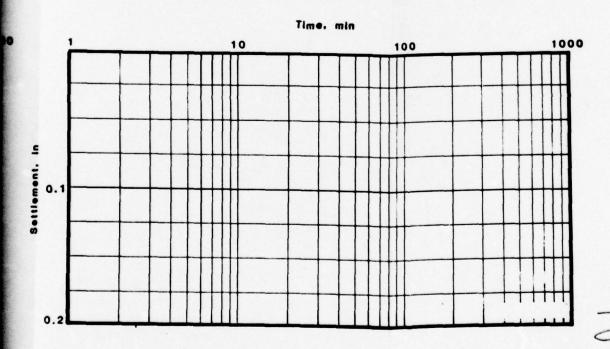
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

DACW43-78-C-0005

Woodward-Clyde Consultants

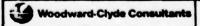


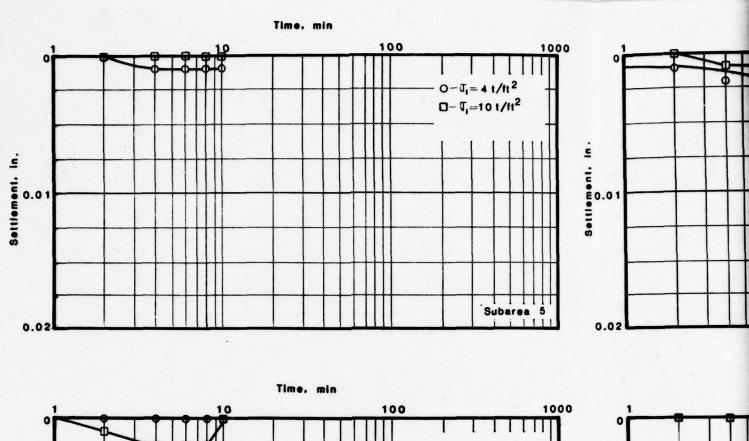


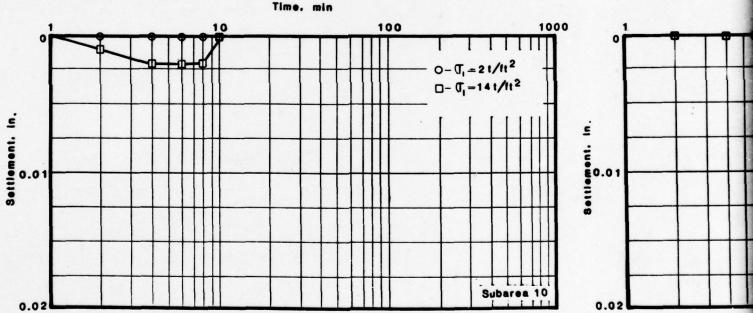


# CREEP RESULTS FROM PLATE LOAD TEST SUBAREAS 1.2.4

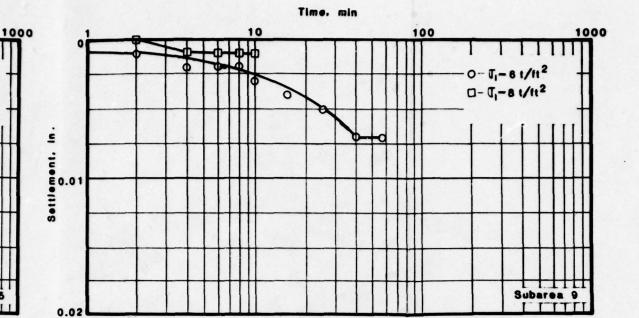
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 20
ST LOUIS DISTRICT, CORPS OF ENGINEERS.
DACW43-78-C-0008

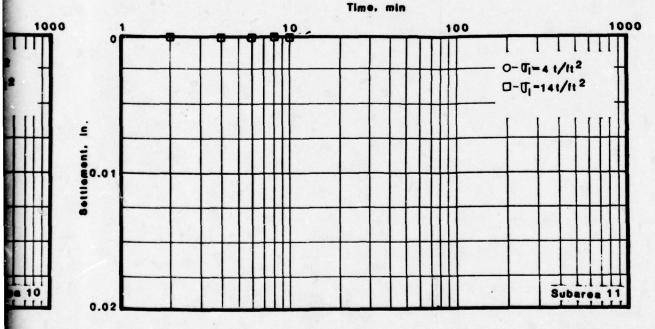






Note: Settlement scale is increased 10 times to .0025 in/division



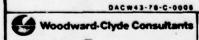


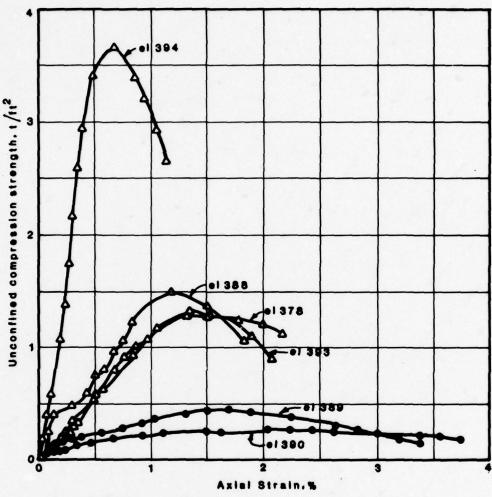
ereased 10 times to .0025 in/division

CHEMICAL GROUTING TEST PROGRAM

CREEP RESULTS FROM
PLATE LOAD TESTSUBAREAS 5.9.10.11

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.





#### Legend

- . Boring AG-A1-4 35% Siroc 142 Test Subarea 1
- △ Boring AG-A4-3 35% Siroc 142 Test Subarea 4

0

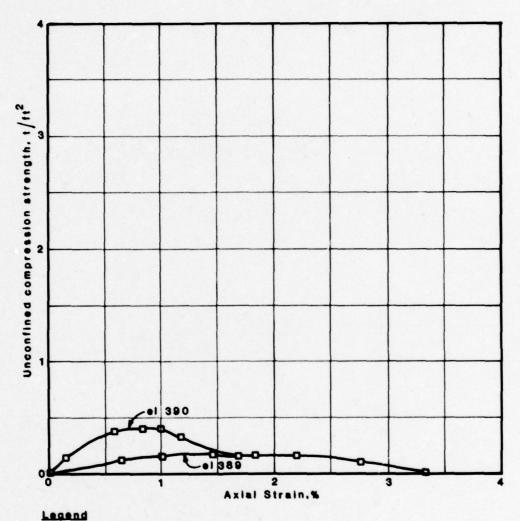
RESULTS OF UNCONFINED
COMPRESSION TESTS
BOREHOLE SAMPLES
35 % SIROC 142

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0005

Woodward-Clyde Consultants

Fig. G.21

Y7C825 Phase II



Boring AG-A3-3 28% Silicate/R600 Test Subarea 3

CHEMICAL GROUTING TEST PROGRAM

RESULTS OF UNCONFINED COMPRESSION TEST BOREHOLE SAMPLES 28 % SILICATE/R600

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0008

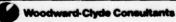
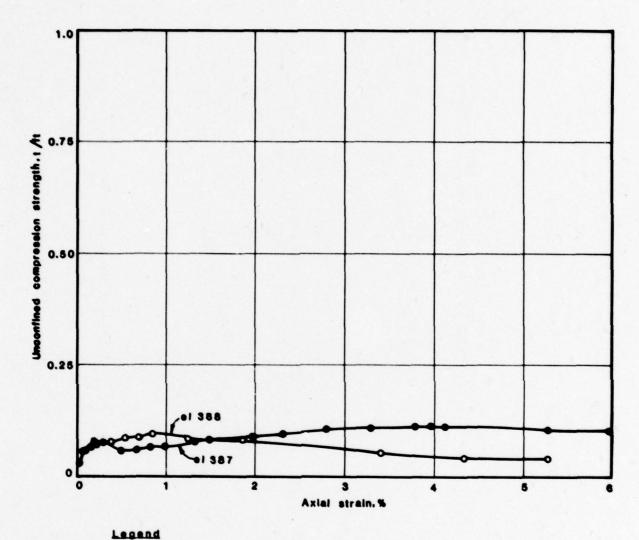
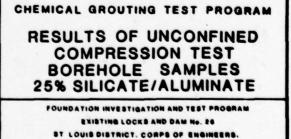


Fig. G.22

Y7C825 Phase IX

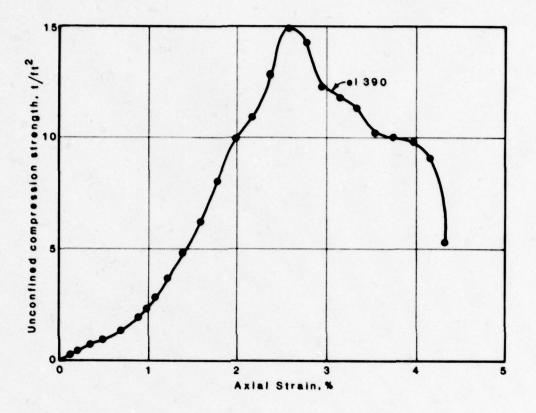


O Boring AG-A8-4 25% Silicate Aluminate
Test subarea 8



DACW43-78-C-0008

Woodward-Clyde Consultants



#### Legend

Boring AG-A11-4 55% Siroc 132/142
 Test Subarea 11

CHEMICAL GROUTING TEST PROGRAM
RESULTS OF UNCONFINED
COMPRESSION TEST
BOREHOLE SAMPLES
55% SIROC 132/142

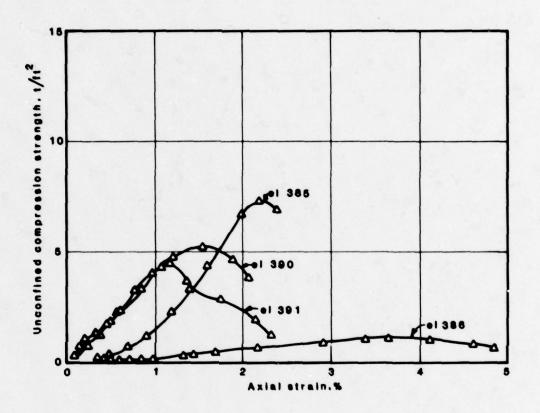
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.

DACW43-78-C-0005

Woodward-Clyde Consultants

Fig. G.24

Y7C825 Phase IX



#### Legend

△ Boring AG-A13-3 46% Silicate/R600 Test Subarea 13

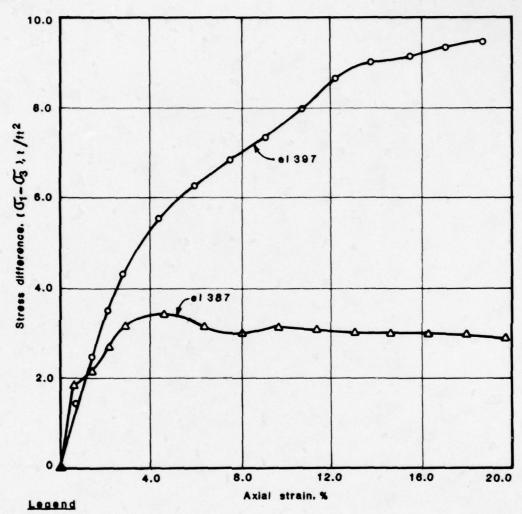
CHEMICAL GROUTING TEST PROGRAM
RESULTS OF UNCONFINED
COMPRESSION TESTS
BOREHOLE SAMPLES
46% SILICATE/R600

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 28 ST LOUIS DISTRICT, CORPS OF ENGINEERS.

Moodward-Clyde Consultants

Fig. G.25

Woodward-Clyde Consultar



Y7 C825 Phase IX

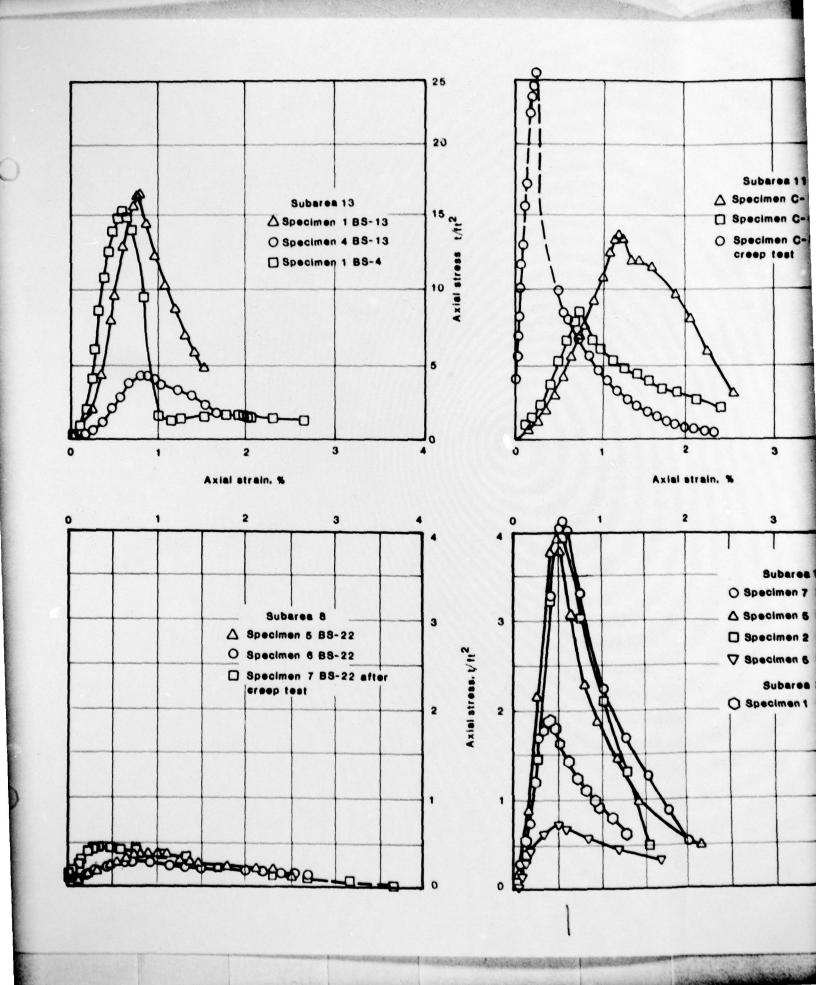
O Δ Boring AG-A13-3 46% Silicate/R600 Test Subarea 13

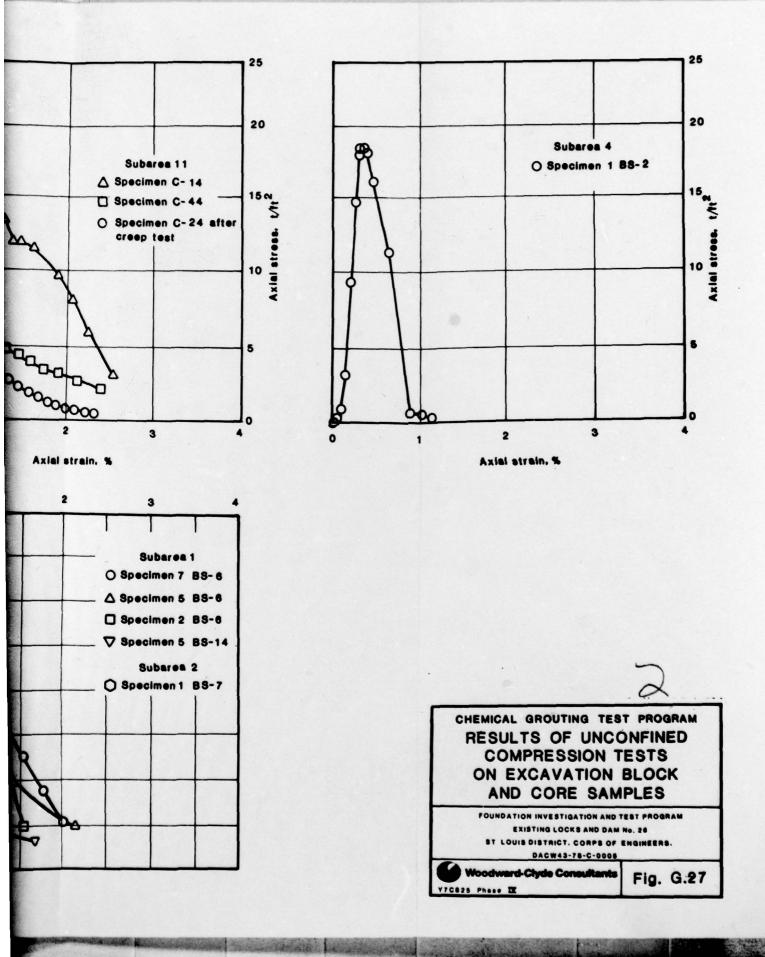
CHEMICAL GROUTING TEST PROGRAM

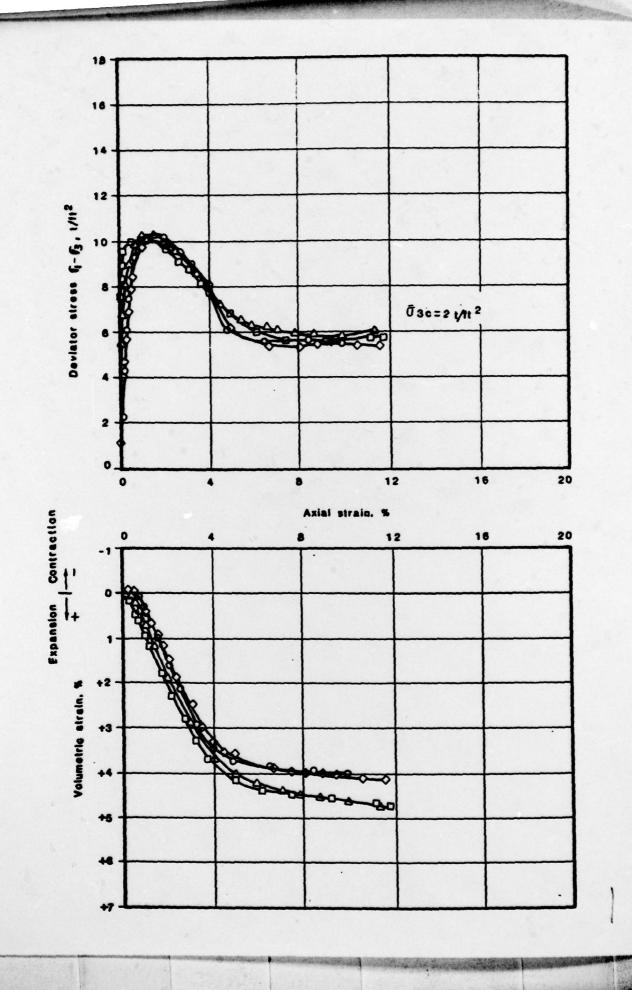
RESULTS OF UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS
ON BOREHOLE SAMPLES 46% SILICATE/R600

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-0005

Woodward-Clyde Consultants Fig. G.26





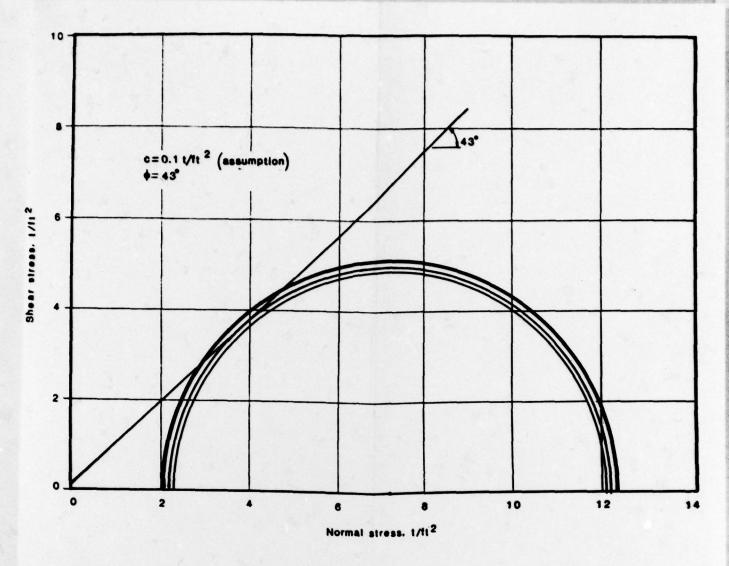




Notes 1 A

2 Te

Sy



- 1 Axial strain rate 0.5 %/min
- 2. Test specimens were 2.8—in.-dia and 6.6-in.-high

LO		

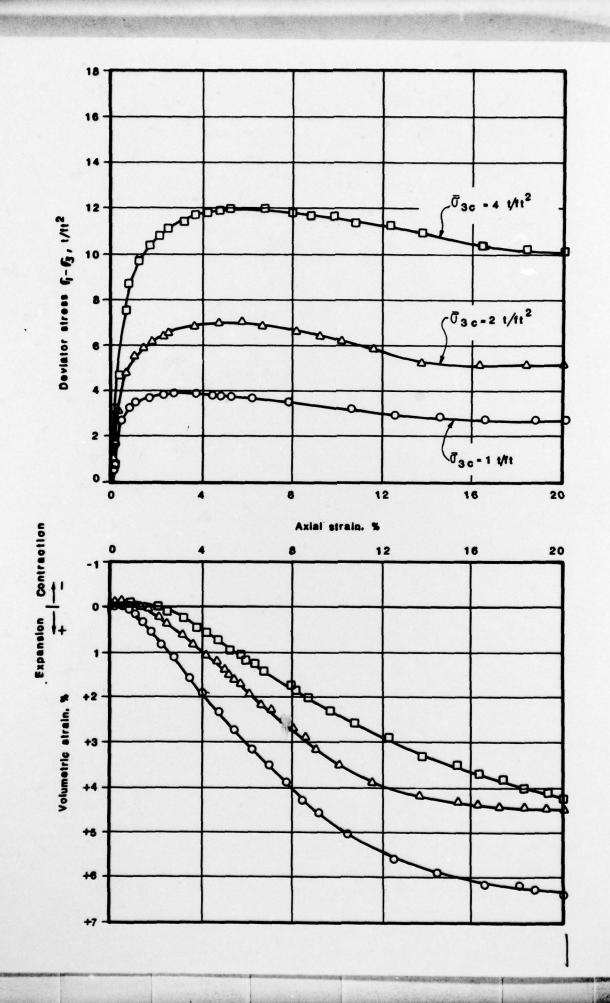
Symbol	Specimen No.
0	3
٥	77
0	after creep test
•	6.



CHEMICAL GROUTING
TEST PROGRAM
RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
UNGROUTED RECONSTITUTED
SAND SAMPLES

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DACW43-78-C-9005

Woodward-Clyde Consultants



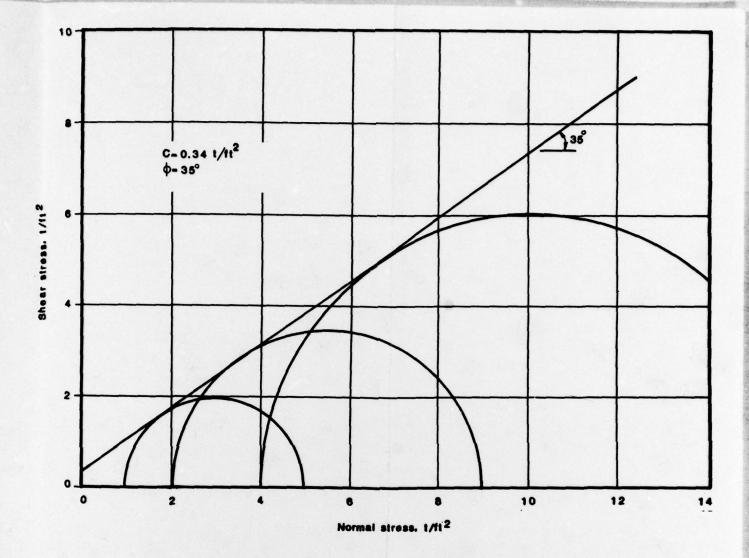
6



1 Axl

<sup>1</sup> Axi

<sup>2.</sup> Test 6.6-



- 1 Axial strain rate 0.5 %/min
- 2. Test specimens were 2.8 -in.-dia and 6.6-in.-high

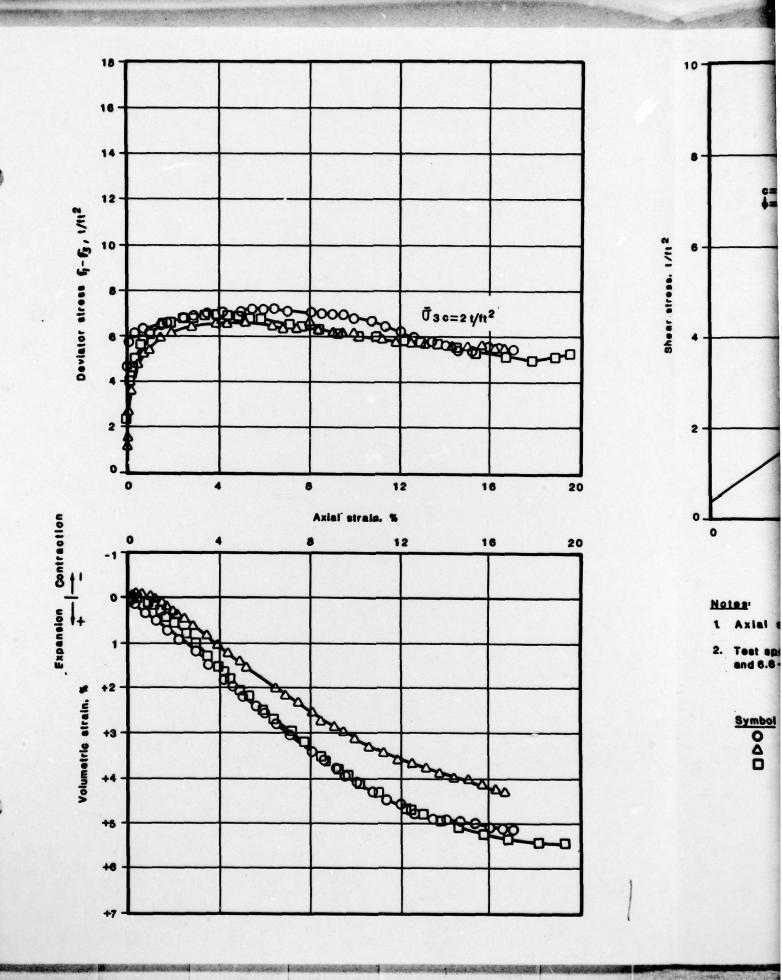


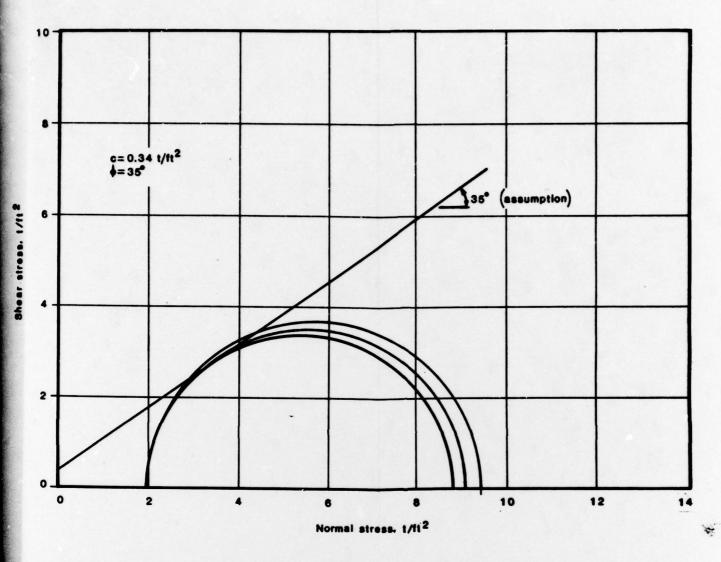
CHEMICAL GROUTING TEST PROGRAM RESULTS OF CID TRIAXIAL **COMPRESSION TESTS EXCAVATION BLOCK SAMPLES** 25% SILICATE/ALUMINATE

FOUNDATION INVESTIGATION AND TEST PROGRAM EXISTING LOCKS AND DAM No. 26 ST LOUIS DISTRICT, CORPS OF ENGINEERS DACW43-78-C-0005

Fig. G.29

**Woodward-Clyde Consultants** 770828 Phase II





- 1 Axial strain rate 0.5 %/min
- 2. Test specimens were 2.8 -in,-dia and 6.6 -in,-high

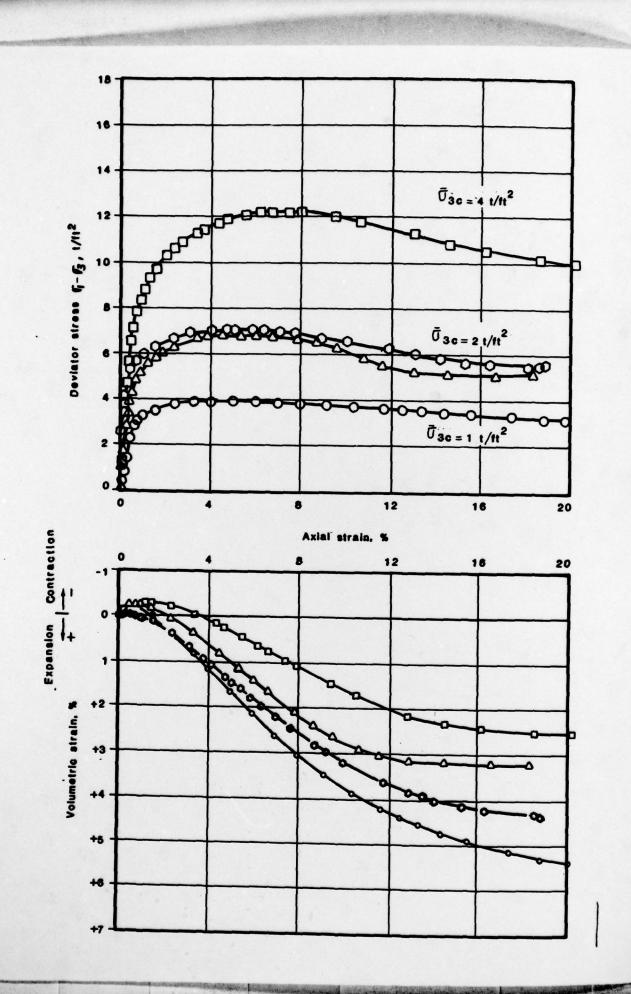
	Legend:	
Symbol	Sample No.	CSR
0	8	68%
Δ	9	10%
0	10	35%

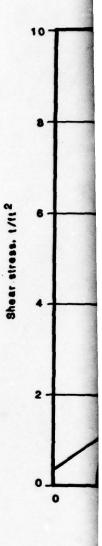


CHEMICAL GROUTING
TEST PROGRAM
RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
AFTER CREEP TESTS
EXCAVATION BLOCK SAMPLES
25% SILICATE/ALUMINATE

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DAGW43-78-C-0005

Woodward-Clyde Consultants
Y76828 Phase IX

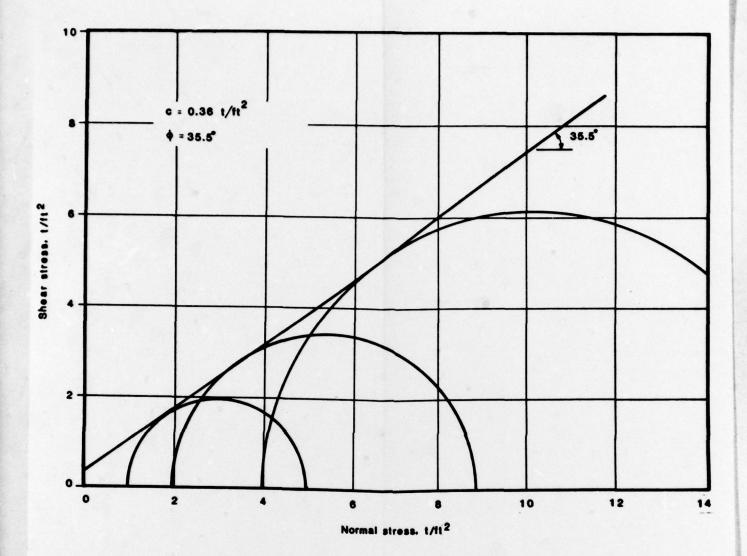




1 AN

1 Ax

2. Test



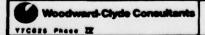
#### Notes'

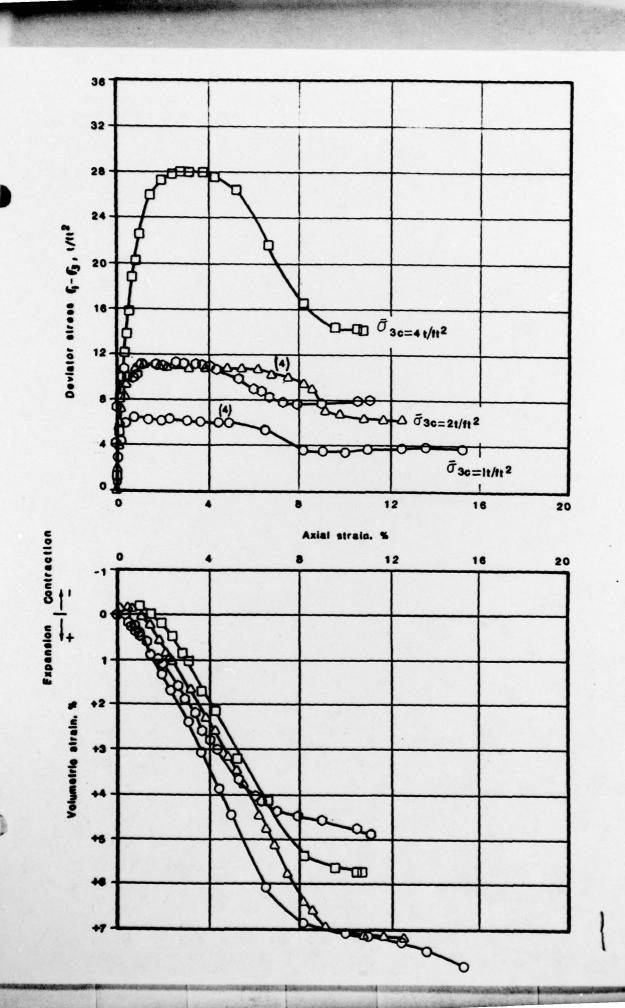
- 1 Axial strain rate 0.5 %/min
- 2. Test specimens were 2.8 -in.-dia and 6.6 -in.-high

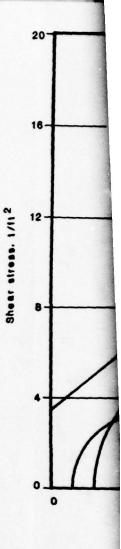


CHEMICAL GROUTING
TEST PROGRAM
RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
EXCAVATION BLOCK SAMPLES
35% SIROC 142, SUBAREA 1

FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT. CORPS OF ENGINEERS.
DAGW43-78-C-0005

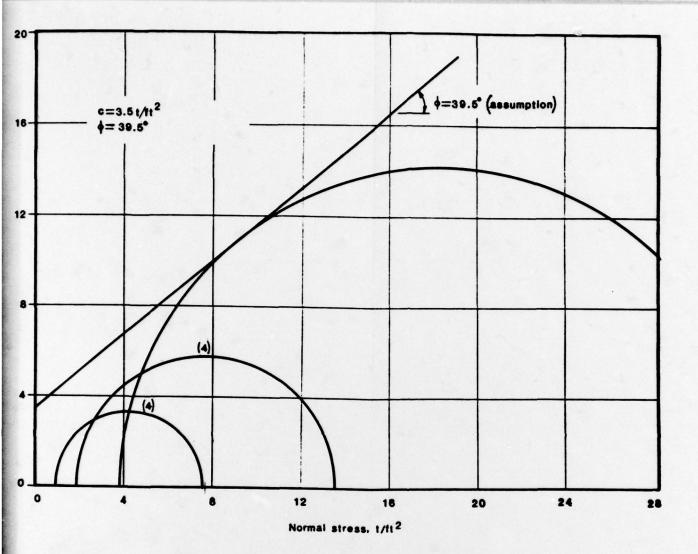






Notes:

- 1 Axiai
- 2. Test spi and 6.6
- 3. Sample was ack undraine and reco
- 4 Samples had ung



- 1 Axial strain rate 0.5 %/min
- 2. Test specimens were 2.8 -in.-dia and 6.6 -in.-high
- 3. Sample tested at  $\overline{U}$  3c=1t/ft was acidentally subjected undrained loading, unloading and reconsolidation
- 4 Samples tested at 0 3c=1,2 t/ft<sup>2</sup> had ungrouted zones



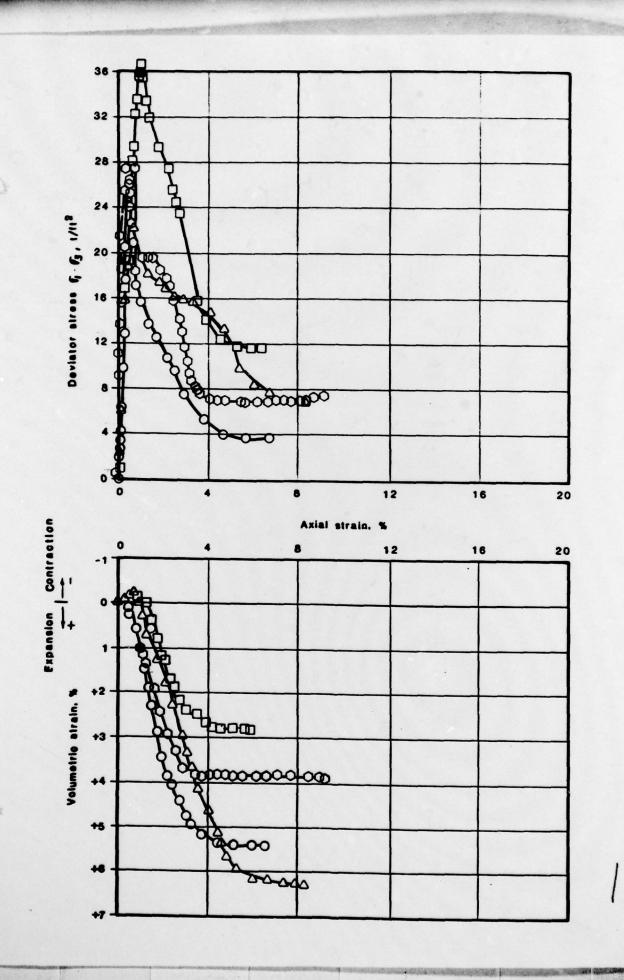
CHEMICAL GROUTING
TEST PROGRAM
RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
EXCAVATION BLOCK SAMPLES
46% SILICATE/R600-

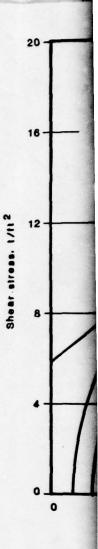
FOUNDATION INVESTIGATION AND TEST PROGRAM
EXISTING LOCKS AND DAM No. 26
ST LOUIS DISTRICT, CORPS OF ENGINEERS.

DACW43-78-C-0005

Fig.G.32

Woodward-Clyde Consultants

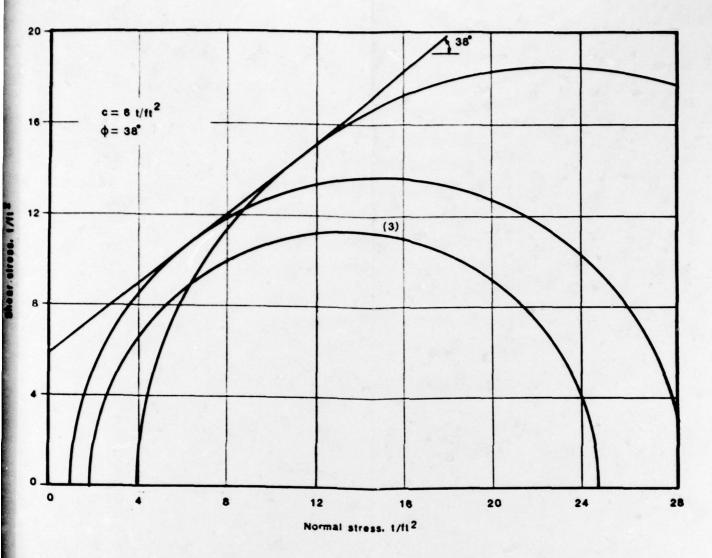




3. Spe

Symbol

000



- 1 Axial strain rate 0.5 %/min
- 2. Test specimens were 2.8-in.-dia and 6.6-in.-high
- 3. Specimen No. 2 (BS-10) had a horizontal discontinuity

-	_	_	_	-	
-	•				

Symbol	Specimen No.	
0	.1, BS-10	
Δ	2, BS-10	
0	3, BS-10 (after creep test)	
0	4, BS-10	



CHEMICAL GROUTING
TEST PROGRAM
RESULTS OF CID TRIAXIAL
COMPRESSION TESTS
EXCAVATION BLOCK SAMPLES
55% SIROC 142

FOUNDATION INVESTIGATION AND TEST PROGRAM

EXISTING LOCKS AND DAM No. 28

ST LOUIS DISTRICT. CORPS OF ENGINEERS.

DACW43-78-C-0005

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